# ELECTRONICS Australia

NCORPORATING "RADIO, TELEVISION AND HOBBIES"

BC certified circulation in excess of 45,000

Volume 28, No. 5

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Offices: 8th Floor, 235-243 Jones Street, Broadway, Sydney, Australia. Phone 2-0944, Ext. 2931, 2508, 2943
CLARRIE LEVY, Rep. Melbourne, 392 Little Collins St. Phone 67-8131.

Circulation:
W. CUMMINGS, Mgr.
Offices: 9th Floor, 235-243 Jones Street, Broadway, Sydney, Australia. Phone 2-0944, Ext. 2505, 2509

Subscription Rates—See back page.

Representation:
Melbourne—John Fairfax & Sons Ltd., 392 Little Collins Street. Phone 67-8131.
Brisbane—Sungravure Pty. Ltd., 78 Elizabeth Street. Phone 2-6688.
Adelaide—John Fairfax & Sons Ltd., 104 Currie Street. Phone 51-3502
Perth—Sungravure Pty. Ltd., 847 Hay Street. Phone 23-4513.
Newcastle, N.S.W.—Associated Newspapers Ltd., 22 Bolton Street. Phone 2-3696.
London—John Fairfax & Sons (Aust.) Ltd., Reuter Building, 85 Fleet Street.
New York—"The Sydney Morning Herald" Ltd., "Times Annex," 229 West 43rd Street.

Distribution:
Distributed in N.S.W. by Sungravure Pty. Ltd., Jones St., Broadway, Sydney, N.S.W.; in Victoria by Sungravure Pty. Ltd., 392 Little Collins Street, Melbourne; in South Australia by Sungravure Pty. Ltd., 104 Currie Street, Adelaide; in Western Australia by Western Press; in Queensland by Gordon and Gotch (A'sia) Ltd.; in New Zealand by Truth (N.Z.) Ltd.; in Tasmania by Davies Bros. Ltd., "Mercury," Hobart.

## The reliability problem

A recent issue of the American journal "Electronics" draws attention to the vast array of electronic equipment which is currently being used in the Vietnam conflict. Communications alone pose a massive problem; individual observers, isolated groups of soldiers, vehicles, spotting planes, helicopters, support aircraft, missile units, all need to be kept in vital touch in a given area. Individual areas have to be linked, communications maintained with other nationals involved in the fighting, and circuits kept open to the Pentagon and White House for urgent decisions that would normally be taken by the commander in the field.

Over and above this is the mass of radar and guidance equipment on the ground and in planes, detection, surveillance, missile electronics and a host of other products from the genius of electronic engineers. The operation in Vietnam serves to emphasise, if such is needed, that war is more than ever an exercise in technology—a great deal of it electronic.

But if engineers can gain from this any sense of accomplishment, the report contains some sobering information about equipment reliability which, strangely, echoes some of the sentiment expressed recently in our "Forum" pages. Despite the experience of World War II and Korea and despite the reputation of the American electronics industry, a significant proportion of the equipment which the forces are using in Vietnam is proving unsatisfactory. It is compromised by moisture, by dust, by heat, by wrong design concepts, by silly faults; military effectiveness is suffering severely because of it.

This is happening despite rigid specifications, inspections and all kinds of environmental testing. It may well be that the incidence of failure per unit component has been forced way down, but such is the multiplication of the total components in service, that the net failure figure is still disturbingly high. And, as dependence on electronics increases, failures which might once have been a nuisance, tend to become disastrous.

We've heard a good deal about reliability in recent years but it looks as though it will have to be pushed even higher in the industry's list of priorities.

Williams

## ugust, 1966

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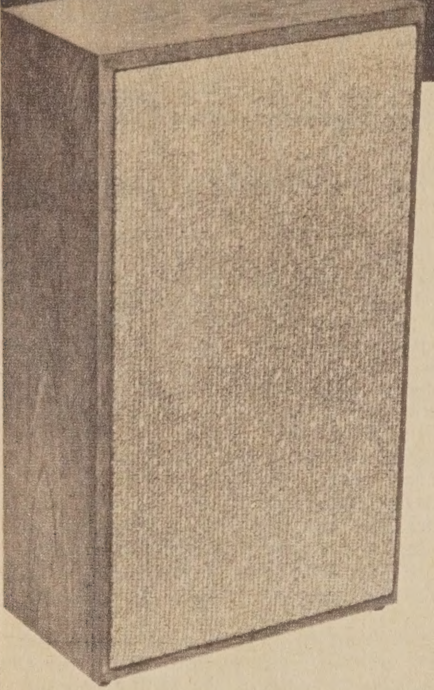
*COVER PICTURE: The 30ft antenna for the Unified S-band (USB) system installed at Carnarvon, Western Australia. It is destined to play a vital part in the forthcoming "Apollo" project which aims to place two U.S. astronauts on the moon. A full story on the Apollo project appears on pages 8, 9 and 11. The Carnarvon Tracking Station is operated by A.W.A. on behalf of the Australian Department of Supply.*

# INSTROL.



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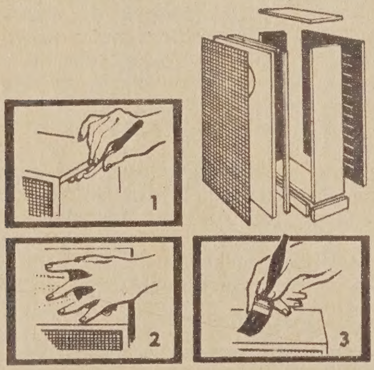

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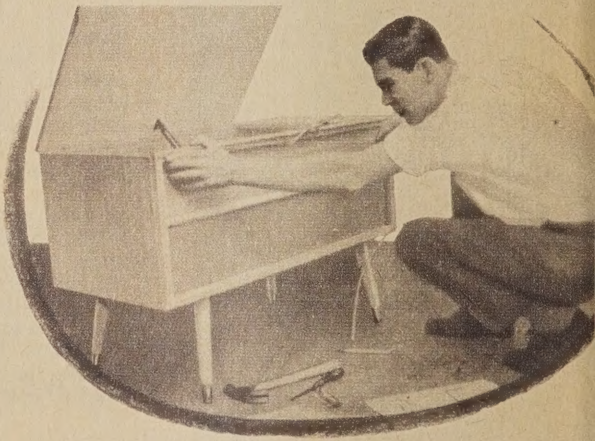

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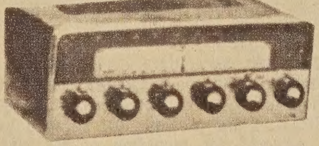

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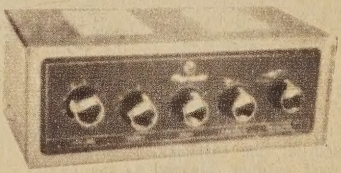

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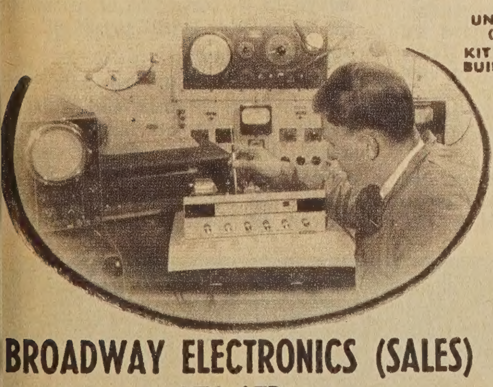

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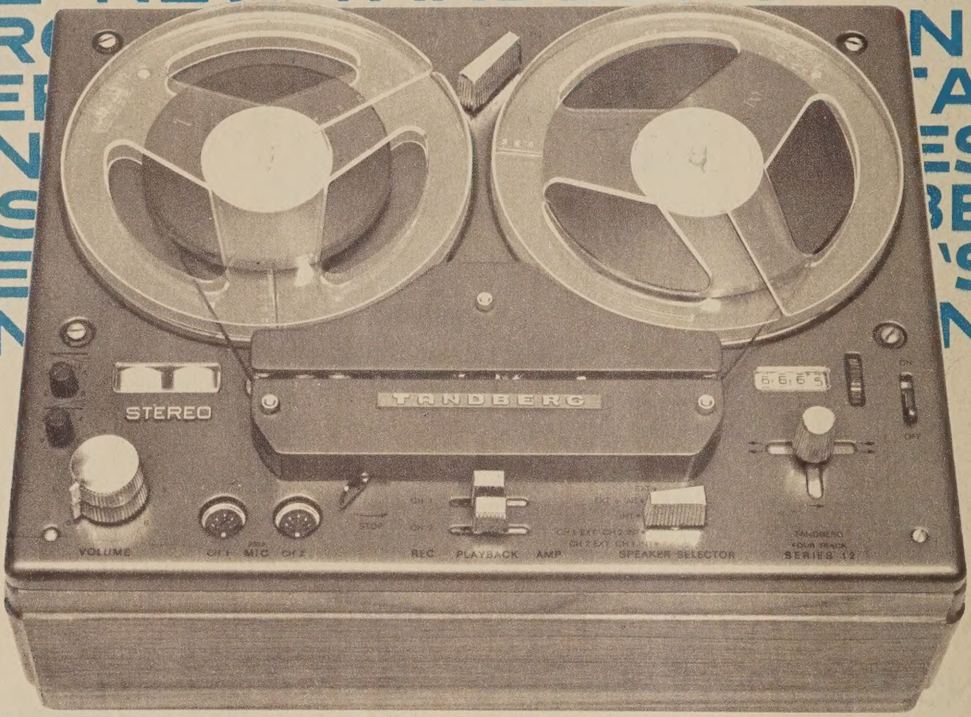

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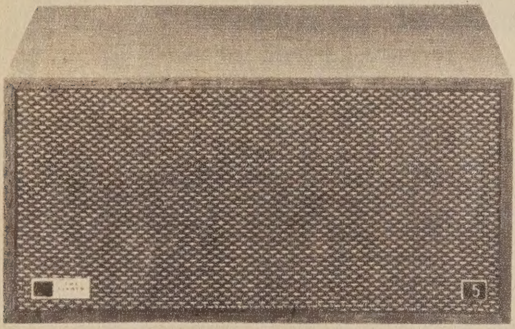

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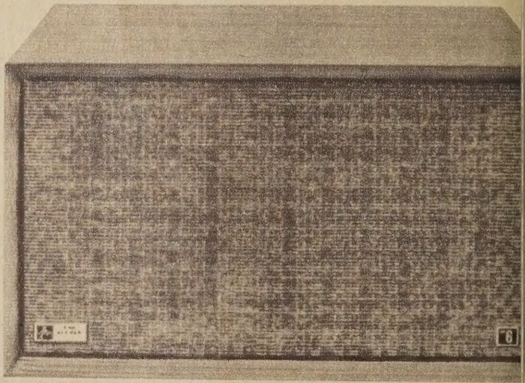

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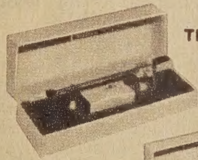
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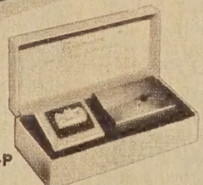
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The new Miracord 40 is priced at $109 complete with Elac 240 cartridge. See and hear it at your hi-fi dealer.

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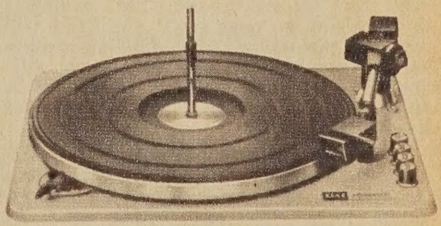

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# CARNARVON, CANBERRA

First Mercury, then Gemini, now Apollo. 1-2-3 to the moon. This is how the National Aeronautics and Space Administration describes its schedule. And as the Gemini program follows Mercury to a successful ending space stations around the world prepare for Apollo.

*Mr Paul Dench, AWA supervising engineer of the USB system and Mr Sam Miller, from Radio Construction Company (U.S.A.) head of the construction team, inspect the USB antenna during its construction at Carnarvon, W.A.*

*This article has been prepared especially f "ELECTRONICS Australia" by AWA engi eers engaged on Project Apollo.*

Their requirements are changing. From the first brief sub-orbital flight, techniques have been developing, programs made more comprehensive. The moonshot brings difficulties never previously encountered and new methods have been developed to deal with them.

The basic Apollo Mission Profile is divided into 6 stages, namely (1) launch, (2) insertion into earth orbit, (3) earth orbit, (4) injection into trans-lunar flight, (5) lunar phase, (6) re-entry. The first, most obvious difficulty is the immense distance involved—approximately 240,000 miles.

A further problem is that, in effect, there will be three spacecraft requiring communication. These are the Saturn S-IVB—the last stage of the launch vehicle which is discarded before achieving lunar orbit—the Command Service Module (CSM) and the Lunar Excursion Module (LEM).

When lunar orbit is achieved, two of the three astronauts will transfer to the LEM, leaving the command pilot in the CSM in lunar orbit. The LEM will then detach and land on the moon. After fulfilling exploratory and experimental requirements, the astronauts will board the LEM for flight back to the CSM. The LEM will then remain in lunar orbit as the CSM prepares for re-entry to the earth's atmosphere.

These various manoeuvres each require accurate monitoring and communication with each spacecraft individually, at distances far greater than those encountered in the earth-orbital flights. To achieve this, either the existing Gemini communications systems would have to be substantially rebuilt and developed, or a complete new system would need to be installed. The National Aeronautics and Space Administration chose the latter course—and thus the Unified S-band System was developed.

For reasons of simplicity of operation, and to minimise the equipment carried aboard the spacecraft, a unified systems approach was selected. Such a system, based on a coherent doppler and digital ranging code, was already in use for the Deep Space Instrumentation Facilities at the Jet Propulsion Laboratory, Pasadena. With the inclusion of voice and data channels, this system could be developed relatively simply to give lunar distance communication capability for manned spaceflight.

A single carrier frequency is utilised in each direction, for the transmission of all tracking and communications data between the spacecraft and ground. The voice and up-date data are modulated on to sub-carriers and then combined with the ranging data. This composite information is used to phase-modulate the transmitted carrier frequency. The received and transmitter carrier frequencies are coherently related. This allows measurements of the carrier doppler frequency by the ground station for the dete mination of the radial velocity of the spacecraft.

In the transponder aboard the spacecraft, the su carriers are extracted from the RF carrier and detected produce the voice and command information. The bina ranging signals, modulated directly on to the carrier, a detected by the wide-band phase detector and translater a video signal.

The voice and telemetry data to be transmitted fro the spacecraft are modulated on to sub-carriers, combin with the video ranging signals, and used to phase-modula the down-link carrier frequency. The transponder trar mitter can also be frequency-modulated for the transmissi of television information.

Provided that the two spacecraft are within the bear width of the single antenna, the USB system can track a communicate with each simultaneously. To achieve this lunar distances, a worldwide network of space stations being established. Three deep-space facilities using 8 antennas will give primary support during the lunar phas They will be backed up by existing Deep Space Instrument tion Facilities at approximately the same locations. The in turn will be supported by 11 ground stations using 3 antennas, five similarly equipped ships and eight aircraft.

In Australia, one 85ft antenna station and one De Space Instrumentation Facility will be in operation ne Canberra, and the Carnarvon Station, with its 30ft antenn will give support to the earth orbital and lunar injecti phases and provide backup for the Canberra Stations wh the spacecraft achieves lunar distances.

To house the Unified S-Band equipment, an entire ne wing has been added to the Carnarvon Tracking Statio The antenna stands some 400 feet away from the buildi in clear view from the windows of the large (25 squar equipment room. Here are the TV recorder and monit and the equipment racks of servo mechanism, antenna driv ranging systems, data demodulation, tracking data processin etc.

The precision frequency source and the time standa are also located here. The purpose of these systems is provide a reliable and accurate tag for tracking and tel metry data, and to supply precision frequencies and pul repetition rates to the various subsystems. The precisi frequency source unit consists of two rubidium resonato and two crystal resonators which are processed throu combiner circuitry. The accuracy of the time standard greater than the accuracy with which the velocity of rad waves (and therefore of light) is known. For this reas range is measured in range units (units of time) which not require conversion using the velocity of light.

# PREPARE FOR PROJECT APOLLO

## —U.S. astronauts on the moon

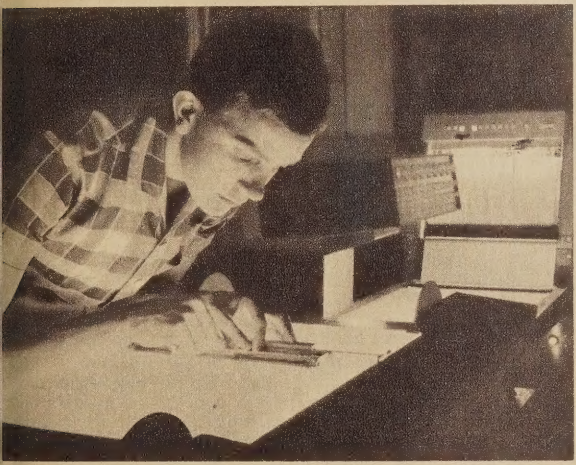
Across the corridor is the Flight perations Room. One entire wall is voted to data display, with a central reen flanked by two large (8ft) back ojection screens. The Flight Controlr can select at will any one of a large imber of prepared slides. A computer ill immediately pick out and display e chosen slide from its position vherever this may occur) within the orage file. Diagrams of systems, maps, iarts or any other relevant informaon may be selected for display on ese screens. Data concerning station atus is shown together with digital ocks in the central section between the reens.

Facing this wall are two rows of conles, each console being equipped with TV screen to display data relevant its function. In the Gemini system, formation was shown by meters in oded form. For the Apollo program, owever, an improved alpha-numeric stem has been developed. All information is displayed as either letters or fig-es, thus making it readily and quickly ecipherable.

Four engineers occupy the first row f consoles. They share responsibility r each of the spacecraft — two moni-r the CSM, one the LEM and one the iturn S-IVB. Behind them on a raised latform are the remaining consoles. wo surgeons supervise the Aeromed ogramme, receiving and checking in-rmation on the medical state of the stronauts. The M. and O. Supervisor is sponsible for the actual status of the ation; and supervising all is the Caple Commander.

Other rooms in the USB wing conin teletype and test equipment. PCM ecommutators and recorder racks are oused in the Telemetry Room shared the Gemini system. The Computer oom is also used jointly by the two stems, although its main bulk of uipment is programmed for Apollo. ie most important are the two Univac 2B computers. One will normally be sociated with digital command for up-ik transmission, and the other with processing telemetry for the down-link. However, in case of emergency, either computer may be programmed to fulfil the function of the other; or even, if necessary, to perform both operations.

Digital commands from the U.S. Mission Control Centre will be transmitted to Carnarvon either through the high-speed (2,400 bits per second) circuits or the teletype links. They will be received and automatically checked by the Command Computer. In the event of a fault in transmission, the computer will automatically initiate a replay. Once the commands have been accepted, they are stored in the computer until such time as they are required for communication to the space craft. During transmission, sample data will be picked off and routed through a receiver back to the computer for a final check.



*Mr Stewart Sands checking BIO-MED data on one of the USB (unified S-Band) recorders.*

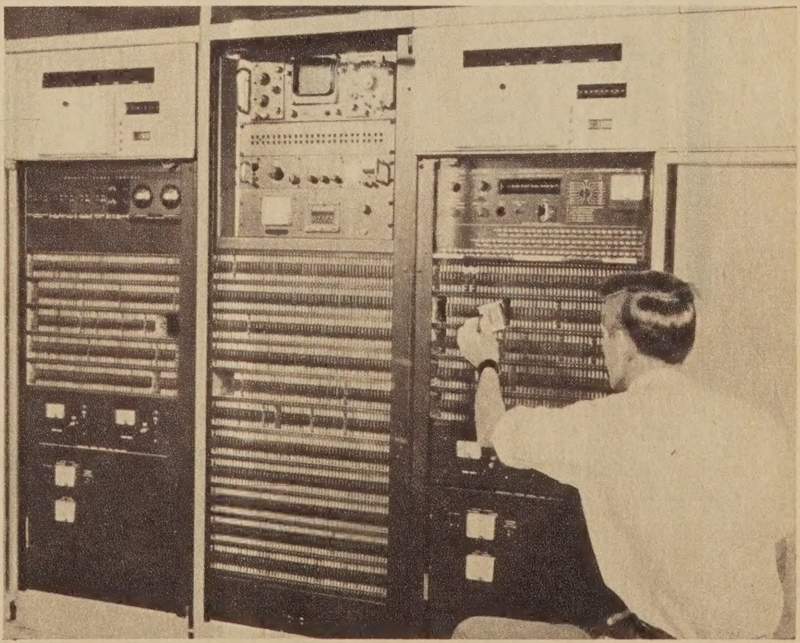
The space craft is also equipped with an error checking system. Once it has accepted a valid command, an acknowledging signal is sent, thus freeing the computer to transmit further commands.

The function of the second 642B computer is the storage and display of data received from the spacecraft. With its associated equipment, it can provide such data immediately either in printed form, or on the cathode ray tube displays; or it can transmit through either the high-speed or teletype links direct to the Mission Control Centre.

On request from a Flight Controller, a Motorola TP 4000 printer can provide printed data at speeds up to 3,000 words per minute. Data received from the PCM will be processed by the telemetry computer and formatted for transfer to the associated Memory Character Vector Generator, from which originates the characters — the actual figure and letter symbols — used in the Operations Room's cathode ray tube displays.

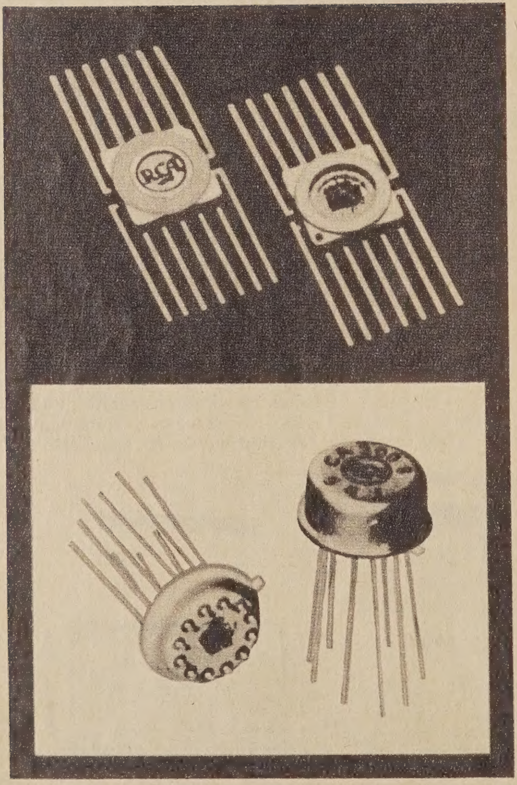
Communication between each of the control consoles and the computers is by means of the Console Computer Interface Adapter. Its function is to provide a link between each of the other equipments. A Univac 1218 computer within this system is programmed to detect the actuation of any switch, establish communication with both the 642B computers, and to format and translate data from these computers to the distribution and storage unit.

In selecting the type of antenna to be used in the Unified S-Band system, consideration was given to the need for tracking through zenith, and of storing the microwave equipment requiring location close to the feed. The X-Y



*Mr Leo Overington servicing the Apollo automatic universal timing system.*

# Low Cost Digital and Linear Integrated Circuits from AWV



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## DIGITAL TYPES

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- 3.6 nsec. average propagation delay.
- High noise immunity (40% related to logic swing).

*HIGH-SPEED ECCSL**

- 6 nsec. average propagation delay.
- Specified for —55° C. to +125° C. operation.

*LOW POWER DTL†*

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## LINEAR TYPES

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- Built-in temperature stability allows —55° C. to +125° C. operation.
- Excellent output to input isolation.
- Inherently matched components.
- Exceptional versatility.
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- DC to 100 MHz.

*Emitter—Coupled Current—Steered Logic (pronounced "Excel").

†Diode Transistor Logic.

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mount was chosen because, in the case of the Apollo mission, much tracking may be required directly overhead. This would not be possible with the convenional azimuth-elevation mount, which cannot track through zenith because of excessive drive rate requirements and reulting instabilities.

The "keyhole" (or area where tracking s impossible) for the X-Y mount appears along the major, X-, axis, which s parallel to the earth's surface and has a north-south orientation. Thus, only argets appearing on the horizon in northern or southern directions are affected by keyhole considerations.

The acquisition antenna consists of a three foot dish mounted above a secondary reflector for the Cassegrainian feed system of the main dish. Below this is the air-conditioned Y-Wheelhouse, containing the boresight package and sensitive microwave equipment which may be subject to line loss, and should therefore be located close to the feeds. The X-axis and the X-wheel assembly, in which is also housed the Y-axis drive assembly, are situated directly beneath; while, at ground level, is the room housing power amplifier units and motor starters for drives.

The acquisition antenna, with a 10 degree beamwidth, is used to acquire the spacecraft in coarse angle. Even before this time, the antenna will have been directed to the appropriate "Look Points" using information previously received either from the computer or on paper tape direct from the Mission Control Centre.

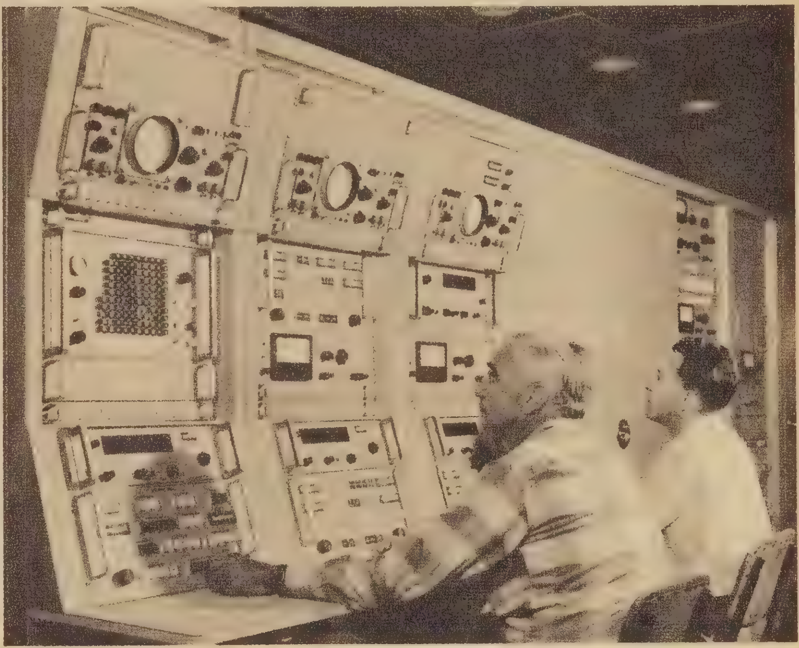
Following the output of the antenna is a switching network. The purpose of the switch is to activate the output of the antenna. This is important as antenna "lock-on" is dependent on interrogation of the spacecraft, and signal reception from the transponder. Due to its position at the apex of the 30 foot antenna quadrapod, the acquisition antenna shares a common optical axis with the 1 degree beamwidth main dish, thus avoiding the parallax problem occurring in the Gemini system. There the acquisition antennas and FPQ 6 and Verlort radars were dispersed across the station site, giving rise to differences in pointing angles.

The acquisition reference channel receiver is utilized with the acquisition antenna. This receiver utilizes a narrowband phase-lock loop in the front end which locks to the received frequency. It takes the difference output of the monopulse feed system in the acquisition antenna. The error developed in the difference pattern is proportional to the angular difference between the electrical axis of the antenna and the angle of the spacecraft. The error voltage being proportional to the angular error is fed o the servo antenna control system, which is used to position the antenna so that the electrical axis coincides with he angle of the spacecraft.

After the acquisition antenna has developed adequate pointing data, the main antenna is switched in to transmit to he spacecraft. The up-link is sent to he spacecraft; the spacecraft receives his frequency, locks to it, and transmits he down-link to the ground station. A wo-way coherent lock can then be achieved, upon which time the full two-way communication and tracking can begin.

Two basic carrier frequencies are used to provide up-link communication with the spacecraft. A simultaneous coherent link is therefore possible with the CM and with one of the other spacecraft.

Because the ground system cannot isolate the two spacecraft missions using the same frequency, angle pointing data can be developed for only one of three spacecraft at the one time. For this reason co-operation between the Canberra and Carnarvon stations may be particularly important, thus allowing each station to track and communicate with one spacecraft during manoeuvre.



*Mr D. Brooks and Mr John Fletcher operating the receiver control system during an NASA checkout of the newly installed USB equipment for Carnarvon.*

The up-link system comprises voice and digital command sub-carriers combined with the binary ranging code system developed by the Jet Propulsion Laboratory. The voice sub-carrier is derived from a 30KHz oscillator frequency modulated with voice from a 100Hz to 3KHz. The digital command update is bi-phase modulated at 200Hz onto a 1KHz/2KHz phase shift keyer, then frequency modulated into a 70KHz sub-carrier oscillator.

The generated ranging code is summed with the voice and updata sub-carriers to form the video waveform that modulates the S-band carriers. It is most important that phase deviations in each sub-carrier are so adjusted that sufficient power is contained in each component, and that a strong carrier component is present in the up-link frequency to enable the transponder to lock-on securely.

In the spacecraft, an omni-directional antenna functions in all near earth phases, while a high-gain antenna is used at lunar distances. The received signal is fed directly to a mixer having a noise figure of about 12dB. A narrow band carrier tracking phase-lock loop having a loop bandwidth of about 1KHz locks to the up-link carrier, which is fed into a wideband phase detector. The ranging code is recovered at video and the sub-carriers are demodulated through a premodulation processor.

The up-link voice is extracted and monitored by the astronauts, while digital commands are fed into the spacecraft computer, either to initiate immediate action or for storage.

The spacecraft's premodulation processor is responsible for the selection of the type of information to be transmitted and the mode of transmission. At different times, only voice and telemetry may require transmission, or transmission may be required in PM and FM modes simultaneously. In essence the premodulation processor is a large switching network, selecting information and adjusting the amount of modulation of each component.

The up-link carrier frequency is translated by a factor of 240/221 before modulation by the down-link information. The new frequency is modulated by the down-link video spectrum, conditioned in the PM exciter and fed to the final amplifier which is a 20 watt travelling wave tube. Voice, telemetry and ranging information are carried by this mode although an alternative FM carrier frequency is available.

Although this is also capable of transmitting voice and telemetry, television transmission from lunar distances is its primary function.

A secondary use is for the transmission of biomedical data. While the astronauts are aboard the spacecraft information such as pulse, ECG, etc., is transmitted through the ordinary telemetry range. In this mission, great importance will be attached to receiving this data from the astronauts while they are outside the LEM exploring the moon's surface. This information will be transmitted through the FM mode.

At the ground station, the outputs are followed by a carrier tracking phase-lock loop for the 10MHz PM output and a modulation tracking phase-lock loop for the 50MHz FM output. A set of demodulators follow these loops for each component in the different data outputs.

(Continued on Page 172)

# TIME-SHARING: one computer serving many masters

During recent demonstrations at Australian General Electric's Computer Centre in Sydney, an engineer sat down at a Teletype and "conversed" with a computer — feeding in new programs and data, recalling previously stored programs, and having the computer solve typical engineering and business problems. But these were no ordinary demonstrations, for the computer being used was more than 12,000 miles away at G-E's centre at Phoenix, Arizona. Even more importantly, there were some 20 other people using the computer at the same time . . .

### by Jamieson Rowe

The demonstrations were arranged by G-E to show Australian businessmen, scientists and engineers that computer time-sharing is no longer a somewhat esoteric experimental technique, but a fully fledged commercial and practical reality: a development in computer technology which seems likely to have a profound effect upon the application of computers to all fields.

As the name suggests, "time-sharing" itself is simply a system wherein a number of users share the operating time of a computer, with the "sharing" done in such a way that each user is scarcely aware that he is sharing the machine with others. It depends upon the fact that a modern computer can handle and solve problems at a far greater speed than can be fed in by, or assimilated by, a single user. Allowing a number of users to have access to the machine concurrently thus keeps it operating economically at the peak of its capabilities, and also extends the benefits of computer calculation to more and more people.

Although the basic concept does not involve remote operation of the computer, in practice this proves to be one of the features provided by a time-shared system: once it is made possible to gain access to the machine from a number of operating consoles it is a relatively short step to provide that the consoles may be remote. Connection to the computer is usually made either by privately owned direct lines or by standard telephone-telegraph links. (The trans-Pacific COMPAC cable was used during the G-E demonstrations.)

The provision of the remote operation facility extends the potential of the computer enormously; small firms and organisations who could never hope to hire even a small computer can hire a teleprinter console which brings the full capacities of a big computer right into their offices and laboratories. However, in providing this facility the manufacturer is virtually forced to effect a radical simplification of the techniques required to "drive" the machine.

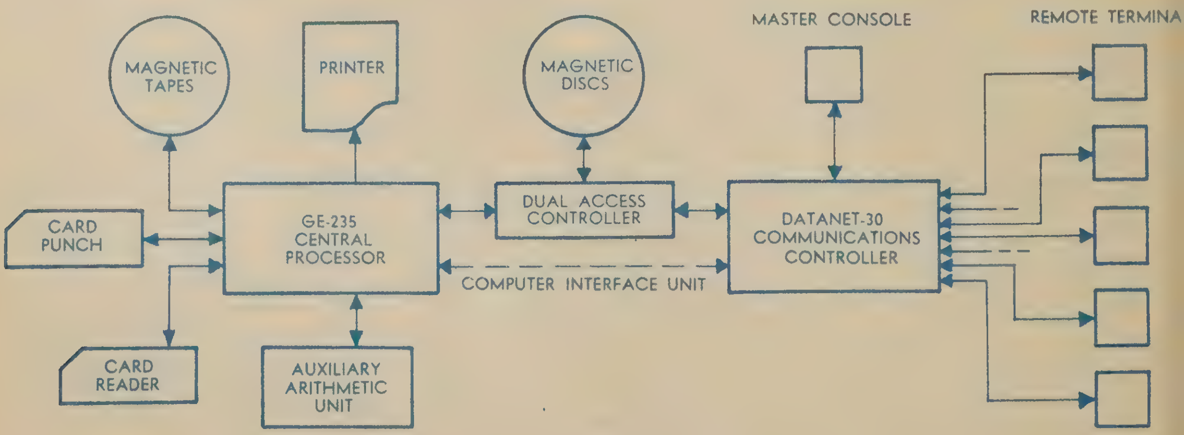
Time-sharing is thus bringing with it new and simplified programming "languages," many of which are little more than clipped and formalised English—for example G-E's "Basic." This simplification of computer operation is tending to do away with specially trained programmers with their role as liaison or "middle man" between machine and user, allowing the user himself to deal directly with the computer after a few hours' training.

The direct link between user and
machine adds a new dimension in co
puter flexibility. The scientist, engine
or businessman can develop for hims
the programs best suited to his particu
problems—often with the help of t
computer itself. He can solve in a ma
of minutes, or less, all those proble
which would otherwise involve hours
even days of manual calculation sim
because they would normally be regard
as "not big enough" to warrant t
services of a trained programmer a
a regular computer. Because he h
virtually "a computer of his own"
is free to experiment in finding n
ways of using it creatively and ima
natively as a thinking tool.

The GE-265 time-sharing system us
in the recent demonstrations illustra
how these advantages are achieved. T
system consists of two main processo
the GE-235, which performs the bu
of the editing, compiling and compu
tion, and the Datanet-30 "stored progra
data communications processor" whi
acts somewhat like a secretary in co
trolling information flow between t
GE-235 and the remote consoles.

The GE-235 has a 6 microseco
memory cycle with a memory of 16,3
words of 20 bits each. It has "floati
point" arithmetic, priority interrupt a
concurrent input-output and comput
tion. The Datanet-30 is a speci
purpose, real-time computer which al
has a memory of 16,384 words. It co
tains the master executive program f
the system, a powerful set of logic
commands and has the ability to co
municate with a variety of extern
devices.

Although fundamentally a bit - pr
cessing machine, the Datanet - 30 h
a special instruction coupled with
relatively simple interrupt program th
permits it to operate, from the use
point of view, as a character - proce
sing machine. It has "bit buffers" whi
disassemble incoming and assemble o



*A block diagram of the GE-265 time-sharing computer system.*

oing characters, the buffers being scaned approximately every eight millieconds.

A disc storage unit provides interediate large-capacity random access torage for both processors, and also acts s the main path for data and instruceon transfer between them in both dirctions. A dual access controller gives oth machines access to the discs, which ave a capacity of six million 20-bit ords. There are 128 read-write heads, our on each side of 16 discs; the averge access time is 150 milliseconds and e transfer rate 256,000 characters per cond.

A supplementary communications link alled the computer interface unit or CIU" also connects the two processors; transfers only one word at a time and ansmits controlling messages between e two machines. The GE-235 also has nventional peripheral equipment such eight magnetic tape drives, a 900 ne-per-minute printer, a 400 card-perinute reader and a 100 card-per-minute nch (these are not accessible to the mote consoles, but used for local batch ocessing), together with an auxiliary ithmetic unit or "AAU."

The system can handle up to 40 reote consoles at once. These are usually 100 word-per-minute Teletype units having optional paper tape reading and punching. Except when connected to the time - sharing system by direct private lines, they are arranged to use normal telephone - telegraph lines in a conventional manner.

*With a time-shared computer system, many users can be operating the machine at virtually the same time from their own offices. Users "converse" with the machine directly, in easily-learned programming language.*

*The GE-235 processor, one of the two computers forming the heart of the GE-265 time - sharing system. This machine performs the arithmetic; the other machine acts as its "secretary."*

The time-sharing schedule of the GE-265 system is arranged so that most users seem to have the system to themselves, despite the fact that they may be sharing it with up to 39 others. The system processes requests on a first-come, first-serve basis which takes into account the probable length of a program by means of a priority system.

Requests given the highest priority are those dealing with previously stored programs. Next come those involving reading-in of new programs, then those involving listing of stored programs, followed in turn by requests to run, edit, etc. The lowest priority of "background" level is given to local batch processing.

While running, a user program runs for a time interval which ends either when the stored data is exhausted, the system reaches a point where a directive must be supplied by the user, the program reaches its conclusion, or its time allotment runs out. The "time allotment" is part of the time-sharing: initial processor time allotment to any program is 2.7 seconds, after which time, if it is not completed, it is stopped and sent back "to the end of the queue" in its priority level.

If a second time allotment is required, this is again 2.7 seconds. If third, fourth, fifth, sixth and seventh allotments are required the time intervals are increased to 5.4 seconds, and further allotments are increased to 10.8 seconds. This graded interval system gives rapid turnaround for short-run programs and editing, yet gives longer programs a reasonable share of the system. Really long programs can be put onto punched tape at the remote terminal and processed in bursts by the system automatically.

The executive program of the GE-265 system provides for two modes of operation: "real-time" and "spare-time." Real-time mode covers the transactions with the users, including the local peripheral equipment. Spare-time mode covers the time between user transactions, being used to update and catalogue a "library" of general-purpose programs and for the execution of such tasks as keeping the users' accounts.

The G-E time-sharing system provides what is called "on-line, real time" service. "On-line" means that the computer can be called directly from the remote station; "real-time" means that data can be accepted, processed and

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- Possess a University degree in aeronautical, electrical or mechanical engineering, or
- Have a diploma in a branch of engineering (preferably aeronautical, mechanical, electrical, automotive, electronic or instrument) which entitles him to Corporate Membership of a Professional Chartered Technical Institute without further examination.

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**Rank of appointment.** Applicants who are engineering graduates, diplomates, or have equivalent qualifications, will normally be appointed with the rank of Flying Officer. Other successful applicants will be appointed with the rank of Pilot Officer.

**Salary.** Pilot Officer on appointment $2821 per annum (single) or $3423 if married. Subject to satisfactory service, officers are promoted to Flying Officer after one year's service and to Flight Lieutenant, if University Graduates, two and a half years later (three years in all other cases). Salary is increased on promotion to:—

| RANK | SINGLE | MARRIED |
|---|---|---|
| **Flying Officer** .. .. .. | **$3106** | **$3708** |
| **Flight Lieutenant** .. .. | **$3949** | **$4551** |

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updated in the same interval in which the transaction is taking place.

Two algebraic languages are available for use with the system. "Dartmouth Algol" is a mathematical programming language especially useful for engineering and scientific calculations. Based on standard Algol-60 language, it was developed for the specific requirements of a time-sharing system by the Dartmouth College Computer Centre in Hanover, New Hampshire.

"Basic," mentioned earlier, is an elementary language developed specifically for use with the G-E time-sharing system. Easy to learn and to use, it can be applied to a wide variety of scientific and business problems. Print-out of a sample program in Basic is reproduced, to show the relatively simple nature of the user-machine transaction.

After dialing-up and securing one of the system's 40 lines, the user makes himself known by typing in the greeting "HELLO" and operating the Teletype carriage return to start a new line. The computer acknowledges the user's presence by typing out a request for his identification number — "USER NUMBER."

If the user number given (e.g., "D25727" in the sample) is an authorised one, the computer then asks the programming language to be used, by typing "SYSTEM." The user replies to this by typing "BASIC" or alternatively "ALGOL."

Following this the machine asks "NEW OR OLD," by which it inquires whether the user desires to develop and operate on a new program, or to recall a program previously "saved" in the user's store. In the sample shown the user desired the latter course, and typed "OLD"; whereupon the system asks for the old problem identification — "OLD PROBLEM NAME" — and the user has requested the general library program "INTEGR***." (The three asterisks are used to identify general library programs as distinct from the user's own stored programs.)

Had the user indicated that he wished to initiate and work on a new program, by typing "NEW" in answer to the third question, the system would have replied by asking the identification which the user desired to give the new program—"NEW PROBLEM NAME." A program may be given a name consisting of from one to six numerals or letters, beginning with a letter. Examples are "FLIGHT," "SPIRL2" and "TAX."

General library programs available to the GE-265 user include common engineering, scientific and business problem solution, programs for plotting histograms and X-Y graphs from algebraic functions or tabular data, demonstration games such as "noughts and crosses" and the card game "blackjack," and many others. The catalogue of these programs is continually expanded.

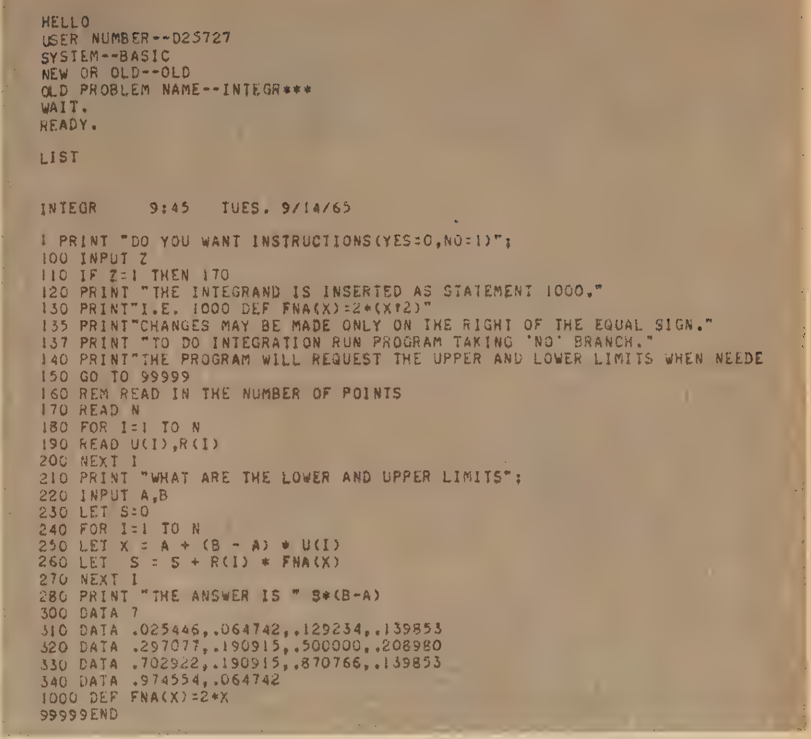
When the system is able to commence processing the selected program it indicates this by typing "READY." In the sample program shown the system was apparently not able to allot processor time to the user immediately, and typed "WAIT." When it was able to proceed it then gave the signal "READY."

At this point the user has a number of alternatives. If he is dealing with an old program he can ask the system to print out a copy of the program ("LIST"), either wholly or partially, or direct it to retain or delete certain portions, or measure the number of characters employed ("LENGTH"), or ask to rename the program, or to commence its execution ("RUN"). If dealing with a new program he can request various types of assistance in assembling and "debugging" it, and can finally ask for it to be stored by typing "SAVE."

In the sample print-out shown the user asked for the old program to be listed, whereupon the system has printed out a copy of the program concerned. Presumably after this listing the user would have readied his data in the appropriate form and then requested the system to "RUN."

When the user wishes to disconnect from the system he types either "BYE" or "GOODBYE." The system then prints out the total central processor time used during the transaction — this does not include print-out time — disconnects, and subsequently amends the user's account by an appropriate amount . . .

It may be seen from the foregoing that computer time-sharing effects quite a considerable change in the hitherto established user-machine relationship. Not only does it make the machine available to a considerably larger number of users who may be quite remote from it, but it allows the users to have virtually direct contact with the machine, by simplifying system operation to the point where there is no longer any need for the "middle-man" programmer. Small wonder that many experts believe that time-sharing will revolutionise the whole concept of computers and computing. ◘



```
HELLO
USER NUMBER--D25727
SYSTEM--BASIC
NEW OR OLD--OLD
OLD PROBLEM NAME--INTEGR***
WAIT.
READY.

LIST


INTEGR     9:45   TUES. 9/14/65

1 PRINT "DO YOU WANT INSTRUCTIONS(YES=0,NO=1)";
100 INPUT Z
110 IF Z=1 THEN 170
120 PRINT "THE INTEGRAND IS INSERTED AS STATEMENT 1000."
130 PRINT"I.E. 1000 DEF FNA(X)=2*(X↑2)"
135 PRINT"CHANGES MAY BE MADE ONLY ON THE RIGHT OF THE EQUAL SIGN."
137 PRINT "TO DO INTEGRATION RUN PROGRAM TAKING 'NO' BRANCH."
140 PRINT"THE PROGRAM WILL REQUEST THE UPPER AND LOWER LIMITS WHEN NEEDE
150 GO TO 99999
160 REM READ IN THE NUMBER OF POINTS
170 READ N
180 FOR I=1 TO N
190 READ U(I),R(I)
200 NEXT I
210 PRINT "WHAT ARE THE LOWER AND UPPER LIMITS";
220 INPUT A,B
230 LET S=0
240 FOR I=1 TO N
250 LET X = A + (B - A) * U(I)
260 LET  S = S + R(I) * FNA(X)
270 NEXT I
280 PRINT "THE ANSWER IS " S*(B-A)
300 DATA 7
310 DATA .025446,.064742,.129234,.139853
320 DATA .297077,.190915,.500000,.208980
330 DATA .702922,.190915,.870766,.139853
340 DATA .974554,.064742
1000 DEF FNA(X)=2*X
99999END
```

*A sample program in G-E's "Basic" simplified programming language, as it would be printed-out by one of the remote Teletypes. Scarcely more than clipped English, Basic is easily learned by most users in a few hours.*

## GLOSSARY OF TIME-SHARING TERMS

**Background:** A time-sharing technique in which batch processing programs can be run concurrently with the time-sharing system when no time-sharing activity is required of the central processor.

**Batch Processing:** A data processing technique in which like transactions are accumulated until workable "batches" are available for processing.

**Buffer:** An area of the computer memory which stores information temporarily during data transfer, often used for "rate of flow" conversion.

**Character:** One representation of a numeral digit, letter of the alphabet or special symbol.

**Executive Program:** A permanently stored program which provides master control over all functions of the system.

**Message:** A group of characters having meaning as a whole and always handled as a group.

**On-Line:** Operation of a terminal or other input-output device as part of the time-sharing system and under system control.

**Real-Time:** Period of time-sharing operation when the system must perform tasks immediately; for example, scanning of communication lines and communication with the central processor.

**Spare-Time:** Period of time-sharing operation when the system performs tasks which have previously been set aside for later execution.

**Working Store:** The area on the magnetic storage discs containing the texts of programs which the users are either composing or have retrieved from saved store.

# HOLOGRAPHY—3D BREAKTHROUGH

Holography is one of the most exciting breakthroughs in modern research. It holds promise of many things: Some, like 3D motion pictures, are a long way in the future. Others, like better information storage and precise laboratory measurements, are more likely to pay immediate dividends. Either way, the prospects appear almost unlimited.

Holography is a mathematical invention of wave-pattern photography by Professor D. Gabor. It waited some 15 years until the development of laser light source gave it practical significance. Still, it remained an expensive laboratory curiosity until last year, when an innovation by Pennington, Lin, Stroke and Labeyrie made it possible to view holograms in ordinary light.

Although there are many purely technical problems to solve yet, it now appears feasible to develop three-dimensional motion pictures and television; to illustrate books and papers with three-dimensional pictures; to hang on the wall a framed hologram which simulates a window with real three-dimensional views; to optically solve complex problems such as, for instance, air and road traffic evaluation, pattern recognition and the features of surface structure.

If one defines photography as the direct rendering of an optical image into a permanent form, then holography must be termed as indirect photography. It involves two steps: first, making a hologram of an object and, second, viewing this hologram in a particular light to see the image suspended in the air, in front of or behind it.

Due to the basic nature of such reconstruction, the three-dimensional image appears as real as the object itself—except for colour, they cannot be told apart from any aspect. In contrast, a stereoscopic image is an illusion created by viewing two slightly different pictures, and such a stereoscopic image remains almost the same in any direction, whereas one can look around a hologram image.

The name "hologram"—literally standing for "the whole writing" but meaning "the whole picture"—was coined in 1947 by its inventor, Professor Dennis Gabor, F.R.S., of the Imperial College of Science and Technology in London. Professor Gabor has contributed to "ELECTRONICS Australia" by way of a comment to the article "Electronics and Road Safety" in the February, 1966 issue, which also contains a review article on holography on page 17.

In the meantime, more interest has been aroused in holography owing to several advances in theory, and subsequent improvements in practice, such as the use of diffused illumination in making holograms (Leith and Upatnieks), viewing holograms in ordinary light (Stroke), reflection holograms suitable for quantity duplication (Rigler), making holograms in ordinary light (Mertz, Young, Stroke, Lohmann) and techniques for making colour holograms.

The outlook for practical holography brightened further at the eighth annual symposium on electron and laser-beam technology held in April this year at the University of Michigan, when the th
foremost specialists in holography—P
fessors Gabor, Leith and Stroke—
cussed the latest advances and fut
applications of this powerful medium

It appears that almost every las
equipped laboratory in U.S.A., G.
France, Japan, W. Germany and possil
in U.S.S.R. is tackling some aspect
holography. Leading in this field
Michigan State University, Stanford U
versity, Bell Laboratories, Xerox C
Westinghouse, A.M. Optical Co., Perl
Elmer Co., I.B.M., and many others
U.S.A.; National Physical Laborato
A.W.R.E. and others —not omitti
Gabor himself—in England; C.S.F.
France, and Tokyo University in Jap

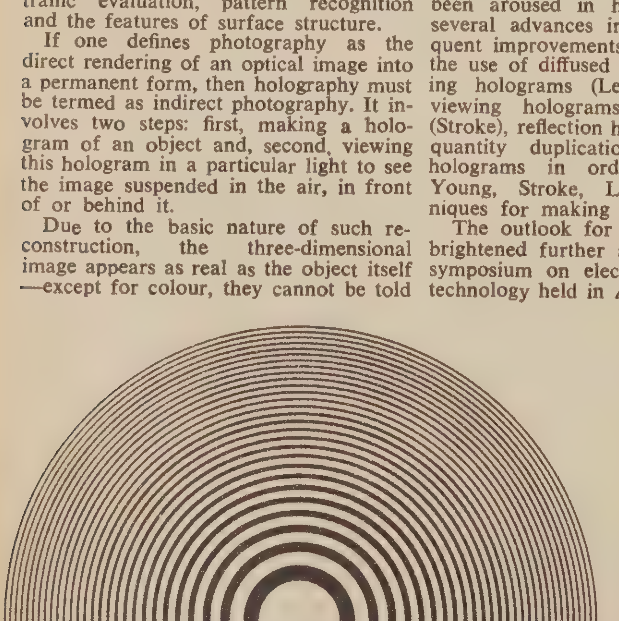
At first, Professor Gabor attempt
immense magnifications with hologran
perhaps of the order of 1,000,000 tim
or more — for observing molecules a
atoms by taking holograms with
electron microscope, and reconstructi
the image from these by means
visible light. The reason for this roun
about method was that electron lens
could not be made perfect, but th
errors could be compensated in the
construction by suitable light-optic
lenses. Experiments were undertaken
the AEI Research Laboratory, Ald
maston, England, in 1950-53, but th
led to only moderate success, because
was found that the electron microscop
at that time suffered from many oth
defects apart from lens aberratio
Seeing atoms by holography remains
this day a line to be explored.

The theoretical formulation of hol
graphy is somewhat complicated. Ele
trical engineers have explained it in th
to them, familiar mathematical metho
used for the treatment of modulatio
frequency spectrum analysis, signal tran
mission and information theor
Opticians prefer to explain it in tern
of Huygens' Principle combined wi
Fourier-analysis.

Practical holography owes its spe
tacular success to the development
the laser, which is a quantum electroni
device. So the electronics enginee
claim that the laser extends their fr
quency range 10,000 times, includi
holography as part of electro-optic
engineering. For example, in the Ele
trical Engineering Department at t
University of Michigan, Profess
G. Stroke conducts a course in "Opti
of the Coherent and Non-coherent Ele
tromagnetic Radiations" in which hol
graphy is the main topic.

Perhaps the difference between phot
graphy and holography could be be
elucidated by the following analogie

The features of a fashion dress f
instance, can be conveyed either by
photo or a pattern. The information
the photo is partial only. The patter



*A Fresnel Zone Plate, the basic element of holographic recording. Although prepared on the drawing board in this case, it is identical with the photographic image discussed in the text.*

**Holography is an extremely complex science, and currently subject to some debate in regard to certain basic principles. This article, however, will give readers an insight into its broad principles and potential. — Editor**

## By Elmar Laisk, M.Sc.

ı the other hand, does not impart an ımediate image of the dress, but it has ı enormous advantage in that the dress ın be reconstructed in three dimenɔns. In this sense the pattern is the ›unterpart of a hologram.

A better comparison is given by the ›ntour-map analogy. A photo of a ountain is a two-dimensional image thout revealing other important traits ch as elevations, distances and slopes l around it. A contour-map is a pattern intersection lines through the mounin according to a set of horizontal ference planes. Such a contour-map ›es not resemble the mountain at all, ıt it enables one to measure any ırt and make a true copy of it, in any ːe. For this purpose one could take a rge number of photos and from them epare a contour-map either by laborus computation or by an easier photoammatic technique (R. TV. & H. Febary, 1965, page 9). In holography, is corresponds to making a hologram. ıe construction of a true model of mountain from its contour-map comres then to the reconstruction of the ıage from a hologram in a laser light am.

Of course, a hologram is not, in any ıse, a contour-map of an object. What is, in essence, unfolds from the way use—or rather misuse—light for ɛing. Almost all we know about the jects around us is carried to the eye light. We see objects by means of ːctromagnetic light waves emitted from lions of points on their surface. Acrding to the Huygens' Principle, light ıves from any point spread spherically the form of equiphase wavefronts.

In theory, a luminous point is co-ːtely identified by any part of its ıitted wavefront, anywhere in space, any instant, as shown in Fig. 1. In ıctice, light wavefronts move 30,000 llion cM. in one second or 30cM. a nanosecond. There are, for instance, ,000 waves of red light per cM. and ːir phase changes 500 billion cycles second. Neither eye nor camera ıld ever record such fast diverging vefronts—unless they produce seconry effects which are stationary, such as ages and interference fringes.

An image of a luminous point is ıally obtained by a lens or a mirror, ich converge a spreading wavefront o a point again, where the eye sees thing else but intensity and colour. e full image of an object consists a multitude of such points whose insity distribution is similar to that of object. An object has infinitely many ages relative to viewing direction and tance. Given one image, all other ws of the object are completely lost.

Suppose that the image of an object carried by n wavefronts, which would photographed instantly. Such a "holom" displays a mesh of n traces, each ıracterised by its intensity and n-1 linations or phases relative to the ıers, totalling $n^2$ data for n wavents. In order to construct an image m such a hologram $n^2$ data are uired for n points; for instance 00,000 equations for 1,000 image nts. Clearly, such a task of wave-

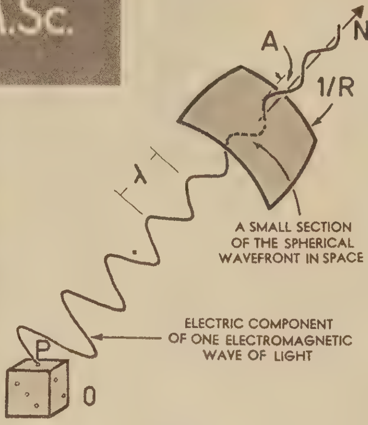

A
N
1/R
λ
A SMALL SECTION OF THE SPHERICAL WAVEFRONT IN SPACE
ELECTRIC COMPONENT OF ONE ELECTROMAGNETIC WAVE OF LIGHT
P
O

*Figure 1 (left). Any point P of a luminous object O emits individual wavelets which propagate in the form of spherical wavefronts. Any portion of the wavefront, although invisible, carries abundant information about P: its direction — by the normal N; distance — by the curvature 1/R; intensity — by the square of the amplitude A; colour — by the wavelength; also waveform, polarisation, Doppler shift, etc.*

*Figure 2 (below). A luminous point S emits spherical wavelets incident on tiny slits P1 and P2, which in turn become coherent sources of new spherical wavelets. These diffracted waves produce, by superposition, interference fringes, which appear here looking towards S on page level. Dark lines and white spaces represent troughs and crests.*

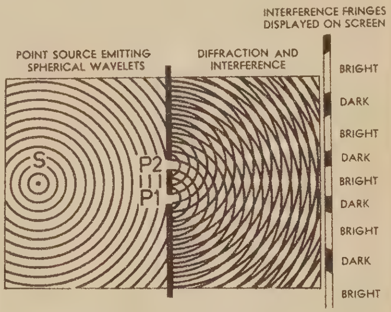

INTERFERENCE FRINGES DISPLAYED ON SCREEN
POINT SOURCE EMITTING SPHERICAL WAVELETS
DIFFRACTION AND INTERFERENCE
S
P2
P1
BRIGHT
DARK
BRIGHT
DARK
BRIGHT
DARK
BRIGHT
DARK
BRIGHT

*Figure 3 (below). Making a hologram of a point. A laser-illuminated point P emits spherical wavelets of which only a sector W, incident to film emulsion E, is shown. A reference beam of laser light, R, is also shone at the angle theta to the film, which records the stationary interference fringes F. They appear looking towards P at page level. Black lines and white spaces are troughs and crests.*

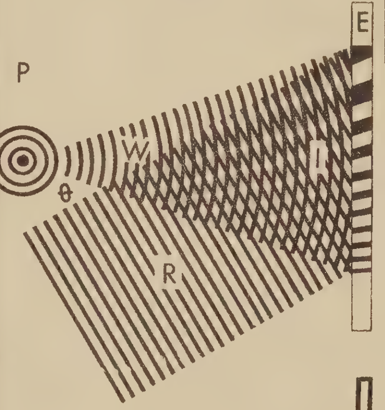
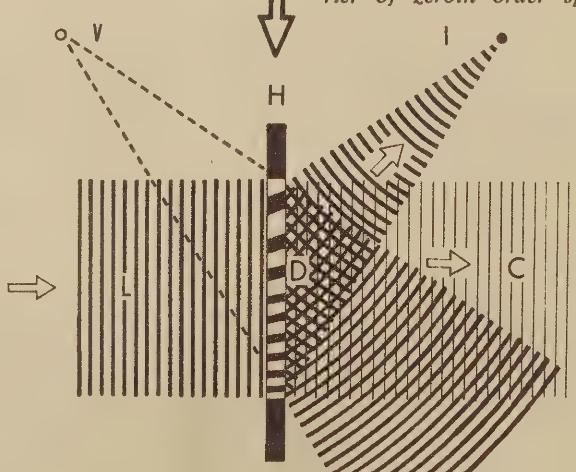


*Figure 5 (below). Viewing a hologram of a point. The processed film E, negative, becomes the hologram H. This hologram diffracts incident laser light into 3 wavefronts: a diverging one, which is an exact continuation of the wavefront W in figure 3 and displays a virtual image in V; a converging one, which produces the real image in I; and, an extension C of the illuminating beam, also called the carrier of zeroth order spectrum.*



front reconstruction appears enormous, even for a computer.

Actually it is impossible to make a hologram of n superimposed waverfronts in ordinary light, because the traces are not stationary. Only monochromatic wavefronts originating from the same point-like source will produce, when superimposed, a stationary interference pattern such as shown in figure 2.

In a laser, however, all the wavelets emitted are synchronised with each other and they remain synchronised or coherent over a long distance; refraction, reflection or scattering do not disturb the coherence of laser light. (Laser operation and coherence are described in more detail in "ELECTRONICS Australia," April, May, 1965).

In coherent light all wavefronts issued from, say n points on an object will give rise to a perfectly stationary interference pattern, which can be seen and photographed as a hologram. As mentioned before, such a hologram has to supply $n^2$ data for the reconstruction of n image points, requiring 1,000,000 equations for 1000 image points or what is more realistic 100 million equations for 10,000 image points. Clearly this is impossible because the finest film would not record such a density of detail and the largest computer would not handle this huge amount of data.

Here Gabor's ingenuity stepped in.

He proved, mathematically, that if an additional coherent light wavefront is provided to intefere with an image wavefront at the photographic plate, as mentioned before, then the resulting hologram is required to supply only two data for each image point: one amplitude value and one phase angle with the reference wave — altogether 2n data for n image points, or 2,000 equations for 1,000 image points.

This extraordinary simplification in making a hologram still left the frightening task of image reconstruction. Earlier, researchers spent months and years in calculating one three-dimensional image from hologram-like X-ray photos. The cleverest part of Gabor's invention was that the hologram itself became a kind of optical computer, a template for the wavefront reconstruction: a beam of coherent light forms itself, at the other side, into an exact continuation of the same wavefront which made it. Once again, the original wavefront appears with all its optical qualities.

Figure 3 illustrates the principle of making a hologram of one point with coherent light waves, about 2,500 times enlarged. An object consists of millions of such points, all emitting spherical wavefronts which superimpose on each other and the reference wavefront on the film.

Obviously the wavefront of each object point intercepts the entire film area, so that its image is contained in every part of the hologram.

A hologram can supply much more information than a photograph. Hence, one interference-sensing eye would appear superior to a pair of image-perceiving eyes. Such a super-eye could adjust itself, presumably, over an enormous range of object sizes, perhaps from molecules to skyscrapers, and over a wide spectrum of frequencies, perhaps from X-rays to mm waves. As there are no coherent light sources in nature, the evolution of the imaging eye has run along its fittest but wasteful course.

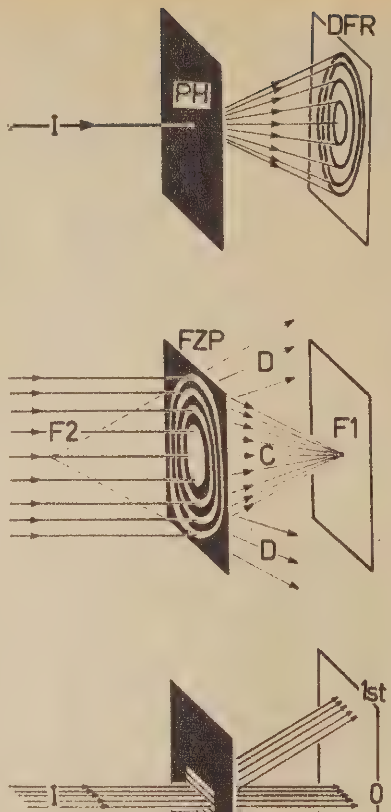


*Figure 4. Hologram elements: pin hole, zone plate, slit. A microscopic pin-hole PH (4a) diffracts incident light I into light cones which produce bright and dark fringes, DFR, on the screen. A large set of pinholes can synthesize all kinds of new wavefronts. A photograph of the diffraction rings of the pinhole acts in reverse: it focuses incident light. A proper Fresnel Zone Plate, FZP (4b), operates like a lens but has a real and another virtual focus, F1 and F2, producing a converging and a diverging wavefront simultaneously. In a hologram, huge numbers of FZP-like elements are made by luminous points. These focusing elements, when properly illuminated, produce the images of the points which made them.*

No camera is required for making a hologram as shown in figure 6. An object is placed in front of a high-resolution film, which is exposed to the reflected and reference light simultaneously. The processed hologram exhibits, when magnified, a randomly granular pattern with countless microscopic pinholes, slits and whorls. These are the essential elements in the hologram; they assemble from incident light an exact copy of the original wavefront.

These key elements, which carry o the reconstruction of the image wav fronts from the hologram, are describe in figure 4; a pinhole, a Fresnel Zon Plate (FZP), and an array of narro slits called a diffraction grating.

A pinhole is perhaps the oldest know optical device, being the essential pa of the pinhole camera. It produc from a luminous point a faint imag which becomes sharper with a small hole. However, if the whole is mad very small the image blurs again b cause diffraction becomes dominant. Th image of the point is then represent by a set of concentric bright and da diffraction rings, which are actually t traces of diffracted light cones issui from the tiny pinhole.

A set of adjacent pinholes produce from incident light, a set of intersec ing light cones whose intensities ma add up in some directions and canc in others; a well-known condition whic brings about X-ray Laue diagrams an side-lobes of a multi-element antenn In fact, a set of diffracting pinhol can project secondary light beams any direction depending on their siz and configuration.

A narrow slit behaves optically lik a continuous row of pinholes. It di fracts incident light and produces lam nar secondary beams: one "in-line," central, and several symmetrically dev ated ones. These diffraction lines ga in intensity with more slits. If t number of slits is very large, say 2 to 10,000 per cM, then the device called a diffraction grating.

This deviates incident light like prism; however, it produces several li spectra as shown in figure 4. A gratin like formation in the hologram pr duces from an incident wavefront ne ones according to the grating formul which determines the directions and t phases of the reconstructed wavefronts.

A Fresnel Zone Plate, FZP, can looked upon as a circular diffracti grating, in which the straight slits a turned into circular ones so that t areas of successive white and black rin remain equal. Hence, their radii a proportional to the square roots of na ural numbers: square root 1, root root 3 etc. Such a FZP behaves like lens of focal length

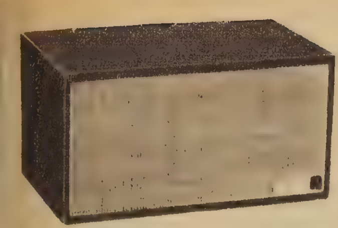
$$\frac{2r^2}{\lambda(cM)}$$

where r denotes the radius of the fir zone and lambda is the wavelength light. For instance, a FZP having a fir zone radius 0.4mm (.016in) focus red laser lights at 25cM (10in).

Fresnel Zone patterns may be presen ed in either positive or negative for depending on the number of phot graphic operations involved, and the are sometimes good reasons why one preferred over the other. The impor ant point, however, is that either patte will re-create the original "positiv light values.

Such a remarkable "negative or pos tive" duality is observed with oth diffractive elements in figure 4. F instance, if the pinhole is replaced wi a tiny obstacle of the same size, the the Fresnel Sone pattern it produces w be identical with that produced by t pinhole. The only difference is that o produces its pattern against a dark bac ground, while the other is against light background.

This duality phenomenon is known optics as Babinet's principle. It explai



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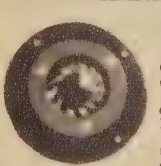

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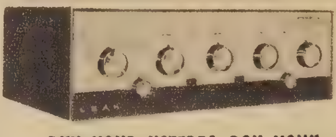

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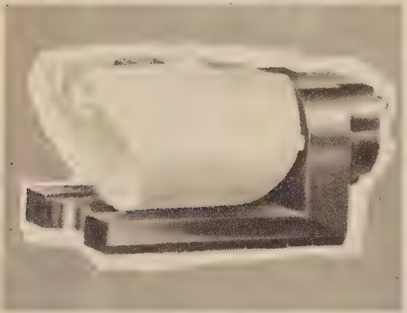

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also, why positive and negative hol
grams always produce positive imag
only. More simply, we may expla
this duality by the intrinsic fact that d
fraction always occurs when a wav
front is intercepted by an opaq
boundary. It is the light wavefro
from such an abrupt boundary whi
give rise to the white-and-dark diffr
tion fringes behind it. At the pinho
the boundary is outside; at the obstac
it is inside—in both cases their ide
tical border-lines emit light wavel
which produce similar diffraction.

The diffraction mechanism is bas
essentially, on the phase relations
tween wavelets from different parts
the clear-opaque boundary. The shape
this boundary alone determines the d
fraction pattern; its sequence—wheth
clear-opaque or opaque-clear—is i
material.

The principle can be applied to ma
diffraction phenomena. It is notable th
Professor G. H. Godfrey, a well-know
optics specialist at the University
New South Wales, derived the theory
wavefront reconstruction from a ho
gram by a form of generalised Babin
principle.

Figure 4, a and b, also reveals
important principle in holography.
pinhole diffracts incident light into
set of bright and dark rings; a simi
set of rings in a FZP converges incid
light into a point again. Such reciproc
is typical of the wavefront reconstru
tion mechanism. A hologram is, in
sence, a complicated diffraction grati
consisting of a huge number of pinho
and slits, both straight and curved, a
their combinations—all located on a
in the film. Both transparent and opaq
"grains" produce diffraction.

A hologram made in the manner
scribed in figure 3 becomes a diffracti
device, which reconstructs from an
cident light beam an exact continuati
of that wavefront which made it. Su
reciprocity can be obtained only und
certain conditions predicted by theo
It also explains the appearance of t
images as shown in figure 5.

The theory itself, as already me
tioned, can be put in the form of
complex version of the RF modulati
theory. In figure 3 a signal frequen
— image wavefronts — is superimpos
on a carrier frequency — referen
wavefronts. The photographic plate
cords the interference pattern—the b
frequency — representing the phases
the wavefronts and their intensities,
amplitudes. Intensity as energy is giv
by the square of the amplitude, so th
positive and negative amplitude valu
give identical densities in the hologra

In figure 5 the hologram acts as
modulated signal generator and a squ
law detector. The two spherical wa
fronts represent the upper and low
sidebands and the in-line transmit
wavefront represents the carrier.

The presence of the two compleme
ary images in hologram viewing is
handicap. More recently one of
images or "spatial sidebands" can
eliminated and this leads then to
"single-sideband" holography.

Practical holography has much
common with interferometry a
spectroscopy, especially in respect
mechanical stability, resolution and
cording techniques. The first pre-req
site is a coherent light source, a las
They are readily available, but exp
sive. There is one made in Adelaide
S.O.L.A. after a design by Dr. J.

## Comment . . .

**Dr W. H. STEEL of the National Standards Laboratory in Sydney is the chairman of the Australian National Committee on Optics and a world-wide authority on interferometry and physical optics.**

*Research in holograms is now one of ie popular fields of optics. At the last ieeting of the Optical Society of merica, at which its fiftieth anniversary as celebrated, the meeting was sumiarised as featuring "history and holorams." The popularity of the subject justified by the spectacular applications precast by Mr Laisk, although there are ome major technical problems still to e solved before we see all of these in veryday use.*

*Unfortunately this research in other ountries is not matched here and I now of no work being done in this eld in Australia, although laboratories orking on lasers, such as the Weapons esearch Establishment, have made holorams by the known methods.*

*I would like to make use of the techique, not mentioned in Mr Laisk's arcle, of hologram interferometry. There ie reconstituted image is superimposed n the original object. An interference attern is formed between the two and iows, in wavelengths of light, any ianges in shape of the object, between e time when the hologram was formed id when it is viewed.*

*Much of the progress in holograms is been made possible by advances in iother field of modern optics, that of sers. Modern fields of optics such as olograms and lasers show how far the bject has changed from being merely the design of better lenses. In fact, the art of lens design is fast vanishing from optics, for it is becoming no more than a program for a computer.*

*Unfortunately, optics still retains some of the reputation for dullness that it gained in the lens-design era. Thus a recent survey has shown that, while 8 per cent of physicists in the United States now work in optics, only 1½ per cent of physics students there are studying it as a major subject. This has led to the strange situation where specialists in the unpopular field are now in the highest demand.*

*To overcome the shortage of trained people, the Optical Society of America is sponsoring a broad program of education. Universities are being encouraged to introduce courses at the undergraduate level in both physics and engineering schools, and "crash courses" are being organised for graduates in other fields.*

*So far these trends do not seem to have influenced this country where optics remains a neglected branch of physics, and is not even recognised as a branch of engineering.*

**Visiting Professor G. H. GODFREY of the School of Physics at the University of New South Wales is an optics specialist keenly interested in holography.**

*If Babinet's principle be extended to apply to what might be described as "phase amplitude" apertures, many phenomena of diffraction including those relating to phase gratings, haloes, phase contrast techniques, zone plates and holograms find a ready explanation in one general formula. The hologram itself may be considered as an essemblage of phase amplitude apertures of a special kind produced photographically.*

**Dennis Gabor, F.R.S., the inventor of holography. He is Professor of Applied Electron Physics at the Imperial College of Science and Technology, in the University of London. A physicist, engineer and inventor, he is well known for his work on information theory, electron microscopy, and matrix theory of light propagation. In a recent article on holography in the "New Scientist" (Jan. 13) Professor Gabor says that he first became interested in wavefront imagery at the age of 17, and this inquiry ultimately led to holography.**

---

imsay of the National Standards Lab-atory. It is a Helium-Neon laser ntinuously emitting about 0.5 milliwatt red light at 6328A° wavelength. age 12, "ELECTRONICS Australia," ay, 1965.)

A laser for the purpose of holography ist operate at a single wavelength, i.e. one axial mode only. Otherwise the am may look "dirty" on a distant een — displaying fringes and grains e to the interference of several modes. ese disturbances can be removed by sing the beam through a pinhole, 10- microns in diameter, placed in the us of a convex lens. The technique is own as spatial filtering because the hole behaves like a lowpass filter passing spatially coherent light only. Any part of the wavefront of such light can interfere with other parts when superimposed, which is essential in laser holography.

At the wavelength of 6328A° the interference pattern may contain several thousand or more fringes per mm. Only high resolution spectroscopic plates can record such fine details, The preferred films for holograms are Kodak 649F and SO-243, also Polaroid High Contrast and several red-sensitive "long range" spectroscopic plates. The type 649F has a resolving power in excess of 2500 lines per mm, some laboratories claim up to 10,000 lines per mm. It is available as film or as glass plate and both are in big demand in U.S.A. Other spectroscopic plates will resolve 300-1000 lines per mm; if the resolution is less the hologram will degrade considerably.

Unfortunately, there is an inverse relation between resolution and film speed so that a very high resolution film like Type 649F implies a long exposure time. Holograms from transparencies can be made in reasonable time in a 0.5 milliwatt He-Ne laser light. Exposure times from 5 to 30 minutes are necessary when making three dimensional holograms from objects in reflected light, especially if it is diffused in order to improve the lighting and allow the three-dimensional effect of the image to be fully exploited.

The extreme fineness of the interference pattern in the hologram dictates extraordinary rigidity in the set-up, such as mounting everything on a massive block to eliminate shocks, thermal effects, and vibrations.

For instance, one version of a "stable table" for holography experiments in the Sylvania Laboratories, U.S.A., was constructed by stacking alternate layers of bricks and rugs, weighing about 2 tons, on inflated rubber tubes placed on the floor. Another 2 ton granite plate set on top of the stack carried the holography equipment—all floating on air.

The spatial separation of the real and virtual images in figure 5 increases with the angle of incidence, theta, of the reference beam. A wide separation conflicts, in turn, with the image quality. In practice, the angle of incidence of the reference beam and the angle subtended by the object are set in a certain relation for best results.

Altogether, there are many variables to be optimised when attempting a really good hologram with a small laser requiring long exposure time. It is possible to holograph moving scenes with a

(Continued on Page 103.)

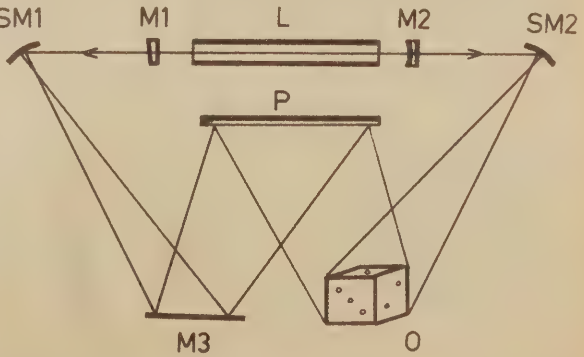
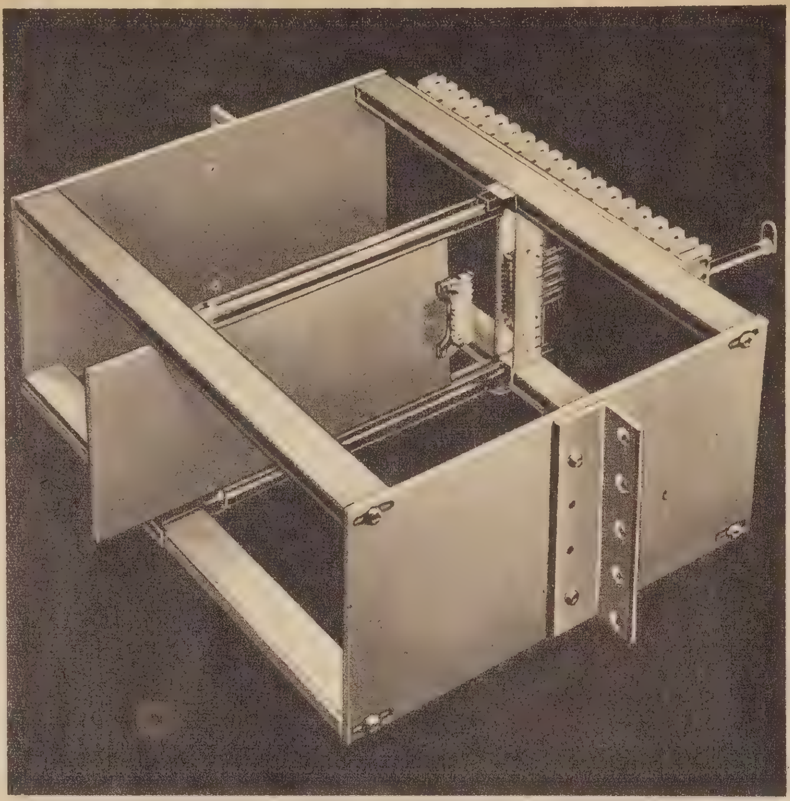
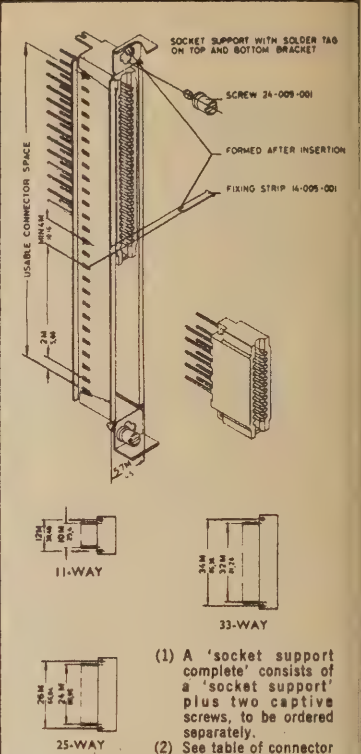


*Figure 6. Making a hologram. A He-Ne gas laser L emits two beams of light from opposite ends; one serving for reference by way of mirrors SM1 and M3, the other illuminating the object O via mirror SM2.*

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FIXING STRIP 14-005-001
USABLE CONNECTOR SPACE
MIN 4M
2M
5.7M
11-WAY
33-WAY
25-WAY

(1) A 'socket support complete' consists of a 'socket support' plus two captive screws, to be ordered separately.
(2) See table of connector combinations.

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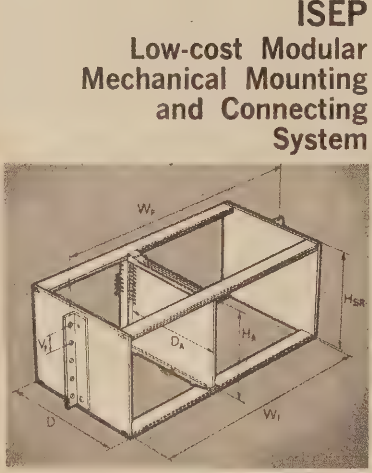
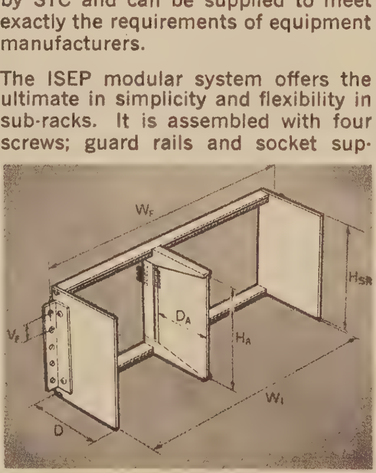

W_F
H_SR
H_A
D_A
V_F
D
W_I

*Four-Rail Sub-Rack*


W_F
H_SR
D_A
H_A
V_F
D
W_I

*Two-Rail Sub-Rack*

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# AKIHABARA

*Cut-price merchandise can be found in any of the scores of little shops in the arcades of Akihabara. Nearly every window has a "Tax free for Tourists" notice on display.*

## Tokyo's Discount Centre

Discounting, long regarded as one of the major evils in the retail field in Australia, seems to be regarded as the main stimulant to thriving and successful business in Tokyo.

### by J. Wondres

That 71b Sony TV set your friend ought back from Tokyo—ask him ere he bought it and chances are he'll y, "Along the Ginza somewhere." Ask he went to Akihabara first, and he'll obably say, "Aki . . . what?"

It is not surprising that this part of kyo is unfamiliar to most visitors. It s no noted tourist attractions—and for opping, it's the Ginza department stores th their English-speaking store guides ich attract most people.

But five minutes away from the Ginza the Yamate line) within the shadow the Akihabara elevated train station the largest electronics and hi-fidelity uipment market in Tokyo—and probly the whole of Japan. This is where ewd shoppers go hunting for real barins. Here, discounts start at 15 per t and have been known to go as high 50 per cent off.

As you get off the train at Akihabara d walk with the crowds to the market ce, the din of a hundred television s, hi-fis, transistor radios, and tape orders just about drowns out the noise the trains overhead. In a triangle out an acre in size are jammed half dozen arcades containing the scores of le shops and stalls.

Clerks stand by their counters, dusting their goods, and calling out "irrashai-seh . . . welcome in! Ah, yessir, we ve lowest prices in Tokyo." (Don't surprised to hear this more than once Akihabara.) During the humid Tokyo nmer, you will be invited to feel the nazing cooling ability" of the four-ed, battery operated fan. If you ould come by during the winter nths, the "superior warming capacity" the electric Kotatsu will be on dis-y.

The Kotatsu is Japan's answer to the oblem of no central heating. It is ically a card table frame with short-d legs. On the underside of the table mounted a heating element. A quilt which can reach the floor is put over the frame, and the table top placed over that. With electric heaters to keep their backsides warm, people sitting around the table in the Japanese fashion, e.g., on floor cushions, and by pulling the quilt up over their knees, can keep supremely warm.

Most of the shops carry the items for which there is a heavy popular demand: the 7lb. TV sets; matchbox sized radios; two-pound tape recorders; radio/phono combinations as big as a box of Kleenex; and pocket-sized transceivers. In addition, many shops specialise in hi-fidelity sound equipment. If some of it looks familiar it may be because it is marketed all over the world under different names and at very different prices. Other stalls sell fluorescent lighting, stoves, refrigerators, and household appliances. And still more handle more sophisticated items such as oscilloscopes, testing equipment, radar and sonar for pleasure boats, Geiger counters, and remote-control radios for model builders.

Since World War II, technological advances and the low cost of labour have made the manufacture of transistorised electronics one of Japan's leading industries. The low prices and tax-free-for-tourists laws practically dare a visitor not to spend money.

Akihabara is essentially a discount market. And while haggling (as many of the Servicemen knew it) has died out, the shopkeepers will not always turn a deaf ear to a little bargaining—**if it is done right.** On items of 3,600 to 5,400 yen, the shopman will probably stand firm on his fifteen per cent off. But if you should be shopping around for $100 to $200 worth of amplifiers, tuners, turntables and speakers, feel free to drive as hard a bargain as you can.

One of the great assets of the Akihabara merchants is their spontaneous way of doing business. They are not like the mechanically polite hostesses who dot the downtown department stores. With their infectious sense of humour, they are a little of the wheeler-dealer, the super salesman and the hometown merchant all in one.

If they have any command of English, they will be most eager to speak it with you. But this "command" can be deceptive. A sale on the verge of closure can easily stall from a simple misunderstanding of a word or gesture. For this reason, if you are planning to spend a large sum, it will be wise to secure an interpreter (for about 1,800 yen a day) through the Japan Tourist Bureau, or the Tokyo Chamber of Commerce. Your interpreter will be able to express your wants honestly, and do it in a manner familiar and acceptable between Japanese businessmen.

If after some bargaining you feel the price isn't right, don't hesitate to visit two, three, or more shops. And by quoting the price given by one shop in another, it may be possible to drive the figure down a little further. (There is the apocryphal story of the Japanese merchant after the war refusing to sell to a westerner because the westerner wouldn't bargain.)

From the time Akihabara opens at 8.30 a.m. — an hour earlier than the downtown stores—to the time it closes (also later than downtown, at 7 p.m. and even later in the summer) there is a continuous scene of happy confusion. Trucks constantly unload cases of factory sealed merchandise into the already crammed aisles. Whole families come and spend the day to select the new "teli-bi." Department store buyers from all over Japan conclude enormous deals over little cups of green tea. And scores upon scores of people just stand around taking in the action.

You can have your lunch while at Akihabara—at one of the two restaurants in the department store built under the elevated railway platform. While you're at it, wander through the grocery department on the third floor which stocks many Western food items; the toy department on the second floor, or the hard-to-pass bakery on the ground floor.

So take along some money, and a smile . . . and good hunting! ■

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ENGINEERING ACHIEVEMENT . . .

# Broadband System Nearing Completion

The opening on April 29 of the $8 million microwave radio link between Brisbane and Cairns brings northern Queensland into the great broadband system which, for the past few years, has been turning Australia's main trunk-line paths into communication super highways.

The new link adds 960 miles to the system which, by 1970, will extend around Australia's coastline from Cairns in the north-east to Port Hedland in the north-west, a route distance of 5,300 miles — or roughly the distance from Sydney to Tokyo.

The 1970 broadband highway will reach down the coastline from Cairns to Brisbane and Sydney, go across to Canberra and Melbourne, turn west to Adelaide, cross the Nullarbor Plain to Perth and then reach north another 1,200 miles to Port Hedland. From Melbourne, there will be an extension across Bass Strait and down Tasmania to bring Hobart into the system.

This is just the main highway. From many places along the way, there will be spurs to extend the broadband network to virtually every major centre in the country.

The complete system will incorporate both microwave radio and coaxial cable links. Already much of the highway is in use. The Sydney-Canberra-Melbourne coaxial cable link was opened in 1962, and the Brisbane-Sydney link which is a combination of microwave and coaxial cable, in 1964. A microwave system between Melbourne and Adelaide will be operating by the end of this year, and so will a microwave link across Bass Strait to Launceston. A broadband system has also been installed over 400 miles of the more populous corner of Western Australia.

This means that, by the end of this year, the broadband system will link all mainland capital cities except Perth. It will also extend to all provincial cities of any size throughout Australia.

Construction of the Brisbane-Cairns microwave link involved the establishment of 29 repeater stations between the terminals at Mount Gravatt and Cairns. Because microwave systems require line of sight between repeaters, these stations have to be set on hilltops about 35 miles apart.

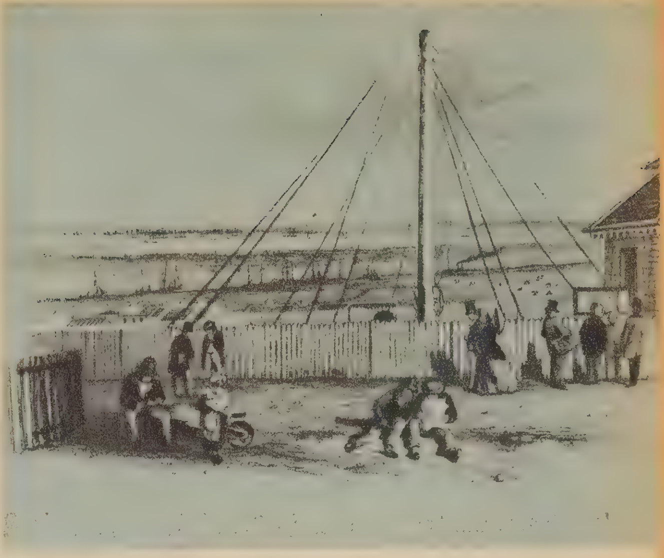
Selection of the sites for the repeaters was in itself a mammoth task. Survey teams slashed paths through some of the toughest jungle country in Queensland, measured a total of 2,800 miles of possible routes before the final choice was made.

Post Office men—draftsmen, engineers, and other technical men — became bushmen camping out in scrubby country, hacking their way through heavy, tangled undergrowth and scaling rough and rocky mountains.

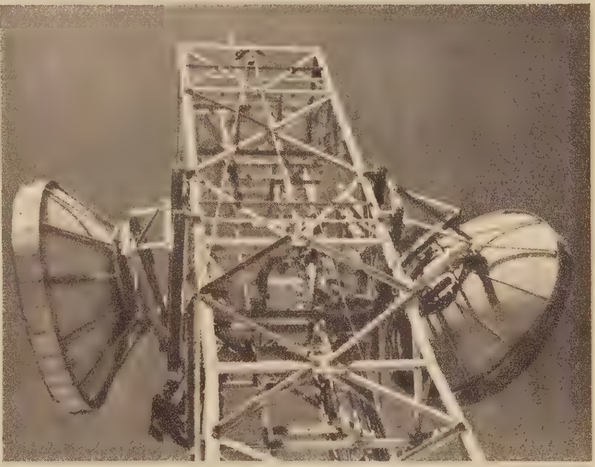
Then, at each point selected, a building had to be constructed to house repeater equipment. A tower had to be raised alongside each building for the aerials — two huge dishes, one facing in direct line of sight to the last station for receiving and the other in direct line of sight to the next station for transmitting. Power had to be supplied at each station, and access roads had to be made.

Just what does the broadband system mean to Australian communications? What kind of traffic will be carried by these great new trunk highways?

The main benefit is that the broadband system, whether coaxial cable or microwave radio, can provide hundreds, or even thousands of telephone channels and telegraph and data transmission circuits. This means that the completed broadband trunk network will have the capacity not only to provide for all Australia's present requirements but also to cater for future needs for many years to come.



*A study in contrasts. Above, an early Melbourne semaphore signal station. Below, a microwave repeater station on the Brisbane-Cairns broadband link.*



*Microwave links operate only over line-of-sight. High above the surrounding terrain, a dish aerial on Black Mountain, Queensland, faces the next link in the radio chain.*

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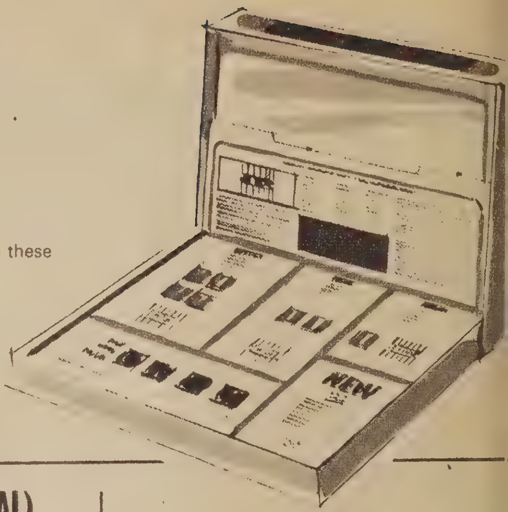

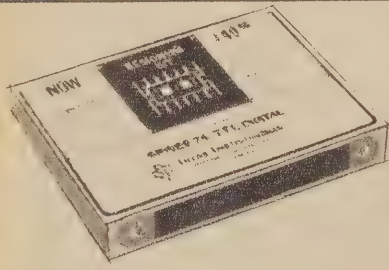

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|---|---|---|
| Propagation delay | 13 nsec | 40 nsec |
| Power dissipation | 10 mw | 60 mw |
| Fan-out | 10 | 10 |
| D-c noise margin | 1 v | 1 v |
| Supply voltage | | |
| Series 54 | 4.5 to 5.5 v | 4.5 to 5.5 v |
| Series 74 | 4.75 to 5.25 v | 4.75 to 5.25 v |
| Temperature range | | |
| Series 54 | 55 to 125 C | 55 to 125 C |
| Series 74 | 0 to 70 C | 0 to 70 C |

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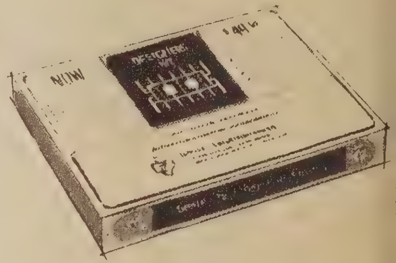

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The opening of a broadband link paves the way for ablishment of subscriber trunk dialling. Because so many annels are available, there are sufficient paths to avoid ns even when hundreds of people in separate cities may int to speak to one another at the same time.

Many subscribers in eastern Australia already subiber trunk dialling which, for the sake of two or three ra digits, makes a trunk call as simple and quick as a al call. Along the busy Sydney-Melbourne coaxial highy, for example, calls now flow with the ease and speed a call to the next suburb.

The broadband network can also relay radio and teleion programs if required. Many of the links with procial cities were established primarily to provide a teleion relay channel.

Internationally too the Brisbane-Cairns link is an imrtant step forward. It is part of Australia's inland conction between the COMPAC cable under the Pacific and SEACOM cable now being laid between Cairns and uth-East Asia.

The COMPAC cable — 9,400 miles of coaxial cable was opened in December, 1963. Its Australian terminal in Sydney. It gives high-quality voice circuits to New ealand, North America and Europe and ends our depennce on short-wave radio, which is frequently interrupted atmospheric conditions, for telephone service with these untries.

The SEACOM cable, scheduled to be completed by the d of this year and to be operational early in 1967, will do e same for telephone service between Australian and Southst Asia. Its Australian terminal will be at Cairns. The dney terminal of COMPAC and the Cairns terminal of ACOM will be linked through our broadband system.

With the completion of the Brisbane-Cairns link, the otlight of broadband interest will turn to other parts Australia. It will fall soon on Adelaide and on Tasmania; will fall too on the Nullarbor Plain where another mamoth construction task will soon begin.

By 1970, Post Office investment in the broadband netork will have exceeded $80 million.

All this is a far cry from the days, little more than 0 years ago, when Australia's first telegraph lines were ected and the telephone was as yet unknown.

Our first telegraph line was from Melbourne to Williamswn in 1854. There was soon more, and, in 1858, Sydney, elbourne and Adelaide were linked by telegraph.

The following year, our first submarine cable was laid ross Bass Strait. A line between Sydney and Brisbane as opened in 1861.

The lines were growing but, as yet, Australia had no mmunication with overseas countries except the mail rvice — ship mail of course, and sailing generally once month.

Then, in 1872, came the overland line from Adelaide to arwin — 1,800 miles of overhead line construction through ugh virgin country. Simultaneously, cable was laid from va to Darwin. Australia was henceforth in the world teleaph system. There were still no telephones.

In 1877, another colossal line construction job brought rth into the telegraph network.

Three years later came the telephone. In 1880, telenone exchanges opened in Sydney, Melbourne and Brisne. They were only two years after the world's first.

With the growth of the telephone service came more nes — and more lines. The network of telecommunication aths spread far and wide. Today's great highways have eveloped from these paths.

("Australian Post Office Magazine," April-May, 1966.)

**1860** *Early days! A single wire telegraph line operating between Sydney and South Head.*

**1872** *A base camp for linesmen engaged in the construction of the overland telegraph line through Northern Territory.*

**1898** *Undergrounding of lines in Melbourne. Note the already heavily loaded poles on the right.*

**1870**

*Telecommunications history is made as the first cable link connecting Australia with New Zealand is laid in Botany Bay, Sydney. At that time the only communication between the two countries was by sailing ship, with a monthly mail service operating.*

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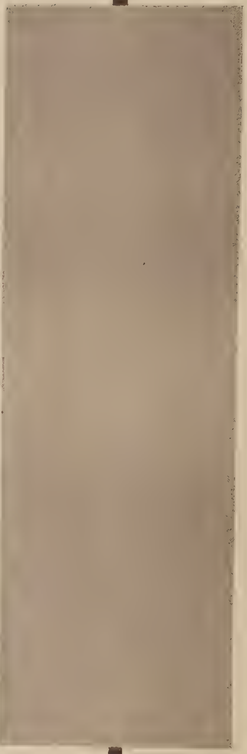

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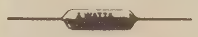
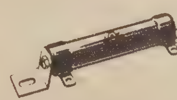
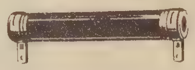
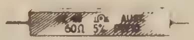
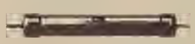
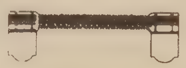
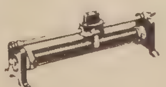
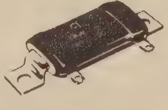
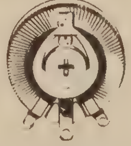
These are just a few examples...

| | | |
|---|---|---|
| <br>Vitreous coated<br>Wire wound<br>1.5 to 14 watts.<br>Bulletin RWV.621A | <br>Tubular, fixed and<br>adjustable Wire wound<br>3 to 200 watts<br>with "Pyrosil" coating.<br>Bulletin PRS.62A | <br>High voltage and High<br>frequency Resistors<br>up to 100 kV, 90 watts.<br>Lead, lug and ferrule<br>types. Bulletin MPMV62A |
| <br>Ceramic case<br>Wire wound Fireproof<br>inorganic construction<br>5 to 15 watts.<br>Bulletin PW.2 | <br>Power Film<br>High Reliabiltiy<br>Mechanically rugged<br>4 to 7 watts.<br>Bulletin PF64AE-1 | <br>Glass insulated Wire<br>wound Silicone<br>impregnated glass<br>fibre core 6-9 watts<br>per inch. Reference:<br>Type AW |
| <br>Sliders<br>Wire wound<br>50 to 200 watts.<br>Bulletin SLS.62A | <br>Flat Wire wound<br>with "Pyrosil" coating<br>20 to 75 watts.<br>Bulletin FRW(a) | <br>Variable Wire wound<br>2 to 100 watts.<br>Bulletin PRA65A |

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# Technical Review

## APPLYING ELECTRONICS TO PUPPET TECHNOLOGY

Science fiction serials using puppets are popular with British television viewers, millions of whom have seen the "Stingray" and "Thunderbirds" episodes. As puppets become more and more refined , electronic control devices play an increasingly important role in production of these series, as explained by John Read, Director of Photography of AP Films Ltd. in this short article.

*Top right: A special effects assistant manipulates the model of the 'Thunderbird' space craft. Below: TV viewers see this realistic view of the spacecraft in flight.*

hunderbirds are go! Most people in ain have heard this introduction to weekly science fiction puppet film ut the activities of a most remarkably ipped rescue and salvage organisation ed International Rescue. As Punch it recently "the essential charm of nderbirds is that it undertakes the oosterous and then makes it seem as istic as possible using models and nated dolls of extraordinary fidelity mechanical ingenuity." What is it n that makes the Thunderbirds go?

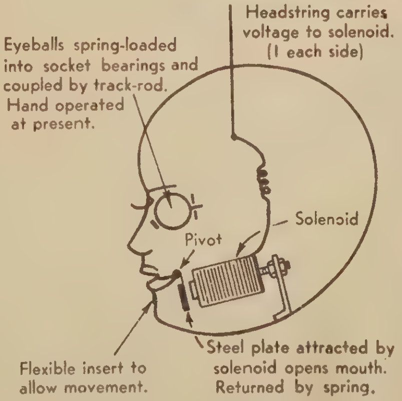
ssentially what we are doing is simply -making; but film-making in full col- with the complications of having ors that are puppets one-third life . Because of this the script cannot as straightforward as one written for ormal production. We must continu- write around the puppet's limitations that they appear for example to k through doors (although the control es make this impossible) or pick up a ee cup (although their fingers are not act jointed).

Our "actors" cannot talk so we must ord the dialogue—mostly in cultured tonian accents—before we start to ot the film. The sound track is played k as the film is being shot and in er to synchronise the movement of mouth with the words we had to ise a method of electrically connect- the puppets' heads with the tape-deck plifier, and also, of course. a means ensuring that the right puppet eaks."

hunderbirds and its predecessors ke considerable use of special effects; to 50 per cent of the film may be thus ssed. We shoot the special effects and activities of the puppets separately different sets to avoid problems of le. An airliner exploding in flight for mple may be no more than 6 inches g or so.

An early optical problem with the tography was parallax arising out of close-range photography the work ded. A director of live actors can nd beside the camera and obtain ually the same view as the camera- n. When the actors are but a foot two from the camera anyone alongside gets a view of the scene quite different from that of the cameraman himself. So director, art director, set dresser and so on had to queue for a look through the camera-lens—a time-consuming business.

Even worse off were the puppeteers who operated from a bridge 7 feet above the set. For one thing they couldn't see the puppets' eyes so the camera crew had to shout directions until puppets who were conversing were looking in the appropriate direction. The answer as we found to both difficulties is a small TV camera mounted behind the film camera looking into the camera's eyepiece with monitors set in suitable positions. This idea has since been adopted commercially and equipment with these electronic viewfinders should soon be available. The next step for us will be to record on to video-tape which we shall be able to play back immediately to check for faults.


Headstring carries voltage to solenoid. (1 each side)
Eyeballs spring-loaded into socket bearings and coupled by track-rod. Hand operated at present.
Solenoid
Pivot
Flexible insert to allow movement.
Steel plate attracted by solenoid opens mouth. Returned by spring.

*This diagram shows how lip movements are synchronised by signals from a tape recorder.*

Our technology has developed steadily throughout the six years we have been making our puppet film series. But there are still many things we would like our puppets to do—to have more mobile features for example and more life-like hands. While wires remain our line of communication we are very restricted but we have hopes soon of introducing some radio control, to broadcast instructions to a receiver in each puppet's head. The scope for technical development is immense. ("New Scientist," Vol. 28, No. 475.)

# PLESSEY

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# SING SAPPHIRES IN COMPONENT MANUFACTURE

apphire, a rare and costly gem; or sapphire, an extremely ersatile and valuable, but not necessarily costly, engineering naterial. Unfortunately, too many persons have the former oncept, which tends to eliminate sapphire from applications where it could be the ideal material.

**by Duane H. Feisel**

e purpose of this article is to des- the unique combination of physical, anical, electrical and optical pro- es which make sapphire an invalu- but not expensive, material in a of industrial applications.

nat exactly is sapphire? It is the crystal form of aluminium oxide, is sometimes also called corundum ngle crystal alumina.

is extremely hard—9 on the Mohs —a useful property in many applica- but which means that fabrication e raw sapphire to the desired con- ation requires the use of diamond ives.

e melting point of sapphire is high: degrees C. It is made by the euil process (sometimes called the -fusion process) which involves ping finely divided, high-purity alu- am oxide powder particles through xygen-hydrogen flame where they ne melted. The tiny molten drop- are accumulated on the top of the ing crystal.

cently, the Czochralski method of th (pulling a crystal from the top molten bath of material) has been ed, but the high temperatures in- d and the attendant problems have r prevented the technique from be- ng commercially important.

e high melting point of sapphire is eful property in that the material be used in applications involving eratures of 1500 degrees C and er.

as-grown sapphire crystal, called ule, cannot be fabricated unless the es and strains resulting from the th process are removed.

is is accomplished in either of two (1) the as-grown boule is split tured) through the centre longitudin- to yield two half-boules; or (2) aling the as-grown boule for an ded period close to the melting of sapphire.

ere are four forms of sapphire es commonly available to the fabri- :

Common, which may be split or e annealed and in which the dia- r is limited to about 1in and the h to about 2in. If the diameter is ased to say half an inch, then the h may reach 4in.

Rod, which is always annealed. rown diameters may be as large as in with lengths to 12in.

Bar stock, always annealed. This , a relatively recent development, be made in diameters as large as nd lengths up to 10in.

Disc, always annealed. Sapphire n in this form is considerably more nsive than the other three, mainly because of the low production yields during growth. Diameters to 3in with thickness to ¼in are common.

In special situations each of these four forms of rough material can be made beyond the sizes indicated.

Sapphire crystallises in the hexagonal system and many of its properties are anisotropic, i.e., they depend upon orientation.

Taken one by one, the properties of sapphire are not particularly extraordinary. But when all of these properties are combined in a single material, then the extreme versatility of this amazing substance is realised.

Scientific literature contains reports of many extensive examinations involving the substance.

Briefly, here is a summary of those properties most widely involved, either alone or in combination with other of sapphire properties, in important industrial applications:

High melting point, 2050 degrees C;

High hardness, 9 Moh or 2000 Knoop;

High transparency, above 70 per cent transmissions from 1550 Angstroms in the UV through the visible, and to 6.5 microns in the infra red, with transmission approaching 90 per cent over much of that range (there are no absorption bands as found in some other materials);

High mechanical strength, bulk modulus of 300,000 per square inch and a modulus of rupture (maximum bonding stress) as high as 100,000 per square inch;

Chemically inert, immune to attack by most acids, but is attacked by cesium vapors and hot ortho-phosphoric acid (which can be used to chemically etch or polish sapphire, at least in the laboratory);

High volume resistivity, approximately $1 \times 10^{12}$ ohm-cm at room temperature, and $1 \times 10^{5}$ ohm-cm at 1,500 degrees C;

High thermal conductivity, approximately 0.1 cal/(cm. sec. deg.C) at room temperature, and about 20 times higher than copper at liquid nitrogen temperature;

Thermal expansion comparable to many metals;

High thermal shock resistance.

Sapphire has had a host of widely divergent applications including infra red windows and lenses, detector cell windows, detector substrates, spectrometer windows; optical filter, microcircuit, and thin-film substrates; wear pads, cryogenic heat sinks, solar cell protective covers, acoustical delay lines, insulating spacers and supports, textile thread guides, dilatometer rods, bearings, ultraviolet photo-cathode tube windows, wear resistant guides, pressure cell windows, and solar simulator windows.

This is an imposing listing of applications where only sapphire possesses the combination of properties required. Several of these applications are of considerable importance or of current interest, and merit discussion.

Electronic substrates: As requirements become more stringent on ceramic substrates, sapphire is commanding more attention in this area.

With tighter requirements on surface finish, material electrical properties, and material uniformity, sapphire has already competitively met the generally much less expensive ceramic substrates.

Advantages weighing in its favour as compared to ceramic materials in substrate applications are: much superior surface smoothness (sapphire is routinely polished to surface finishes of one microinch peak to valley, virtually impossible in unglazed ceramic materials because of grain pull-out from the surface of the polycrystalline substance) higher thermal conductivity, higher volume resistivity, and uniformity piece-to-piece and lot-to-lot—all factors permitting manufacture of microcircuits of better performance and improved reliability.

Silicon has been epitaxially deposited on sapphire substrates in both England (Plessey U.K. Ltd.) and the United States (North American Aviation, Radio Corporation of America), opening the way for active devices on sapphire substrates.

Virtually every electronic component manufacturer in the United States now has a program involving sapphire substrates.

In one major application, Western Electric have made tantalum nitride resistors on sapphire which are of high performance and extremely high reliability.

The factors cited were instrumental in choosing sapphire over a ceramic substrate.

Infra-red detectors: Sapphire is widely used in several specific applications in infra-red detection systems, mainly in the form of lenses, windows and detector materials substrates.

Some of the properties important here are high temperature strength and stability, high shock resistance, high abrasive resistance, high transmission of IR radiation and high thermal conductivity.

Additionally, sapphire can be sealed readily to glass, metal, ceramic and to sapphire itself.

Insulating spacers and supports: In vacuum mounted relays, valves and many types of electrical equipment, the electrical insulation provided by sapphire coupled with high strength and high temperature stability provides a material unmatched.

Since sapphire is a single crystal material with zero porosity, there is no outgassing problems when used in vacuum applications.

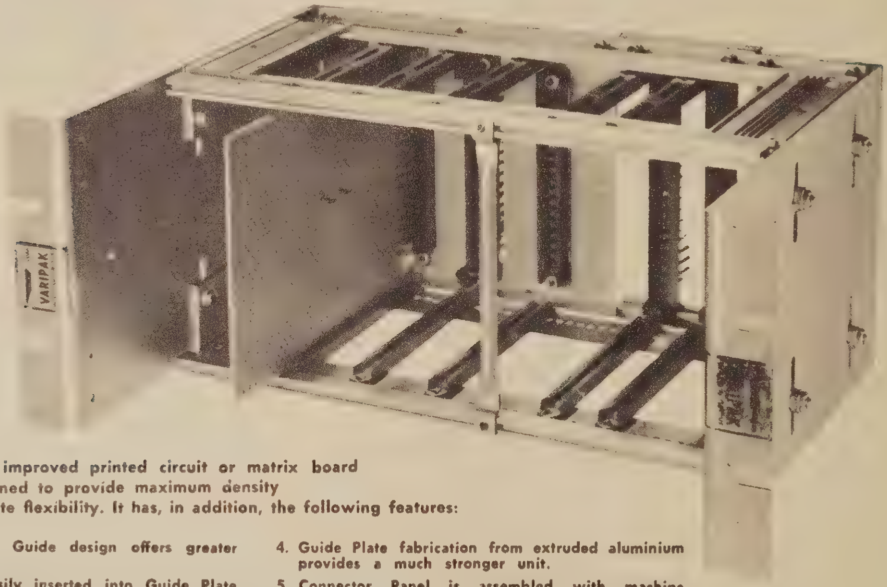
Laser applications: One of the most widely used solid-state laser materials is

**(Continued on Page 174)**

ELCO

# NEW VERSATILITY VARIPAK II

## PRINTED CIRCUIT CARD ENCLOSURE



VARIPAK II is our improved printed circuit or matrix board card enclosure designed to provide maximum density coupled with complete flexibility. It has, in addition, the following features:

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4. Guide Plate fabrication from extruded aluminium provides a much stronger unit.
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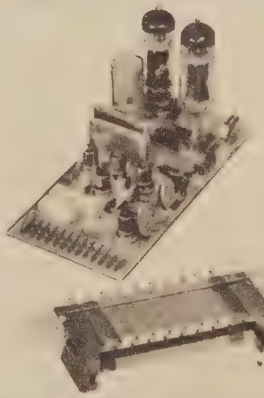
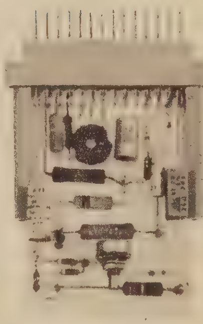
The connector itself is made from individual modules and can be readily altered if this becomes necessary at some later date.





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Technical Data Bulletins 00-5002, 00-5023 and the Vector leaflets may be obtained from any ELCO Distributor

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# SEMICONDUCTOR DEVELOPMENTS IN JAPAN

Recent developments in the semiconductor field in Japan suggests that the Japanese bid to lead the rest of the world in this technology is not to be dismissed too lightly. The following extracts from articles published in U.S.A. in the magazine "Electronics" (Vol. 38, No. 22 and Vol. 39, Nos. 4 and 6) show the progress being made in this field by Japanese scientists.

Japanese researchers were eclipsed by eir American counterparts in the de-elopment of the transistor, but they e making up for it with the development of new diodes. These include the saki diode, the Kita (silver-bonded) ode (Electronics, Dec. 13, 1965, p. )), and now the Mizuno diode. The izuno diode, made of germanium, has highly doped junction and generates illimeter oscillations when biased in e reverse breakdown region.

In their bid for world leadership in lid state microwave hardware, the panese have diodes as trumps. Already saki diodes and Kita diodes are at ork in Japan's microwave link net-ork—the densest anywhere. Now the izuno diode seems likely to strengthen e Japanese hand in years to come.

The diode was developed by a group d by Hiroyuki Mizuno at Matsushita lectronics Corp.'s research laboratory. latsushita is a joint venture of Matsuita Electric Industrial Co. of Japan nd Philips Gloeilampenfabrieken NV the Netherlands.

In experiments, the Mizuno diode as been operated between 10 and 90 Hz at power outputs of up to 10 illiwatts peak. So far, the devices have een operated in a pulsed mode. The ajor obstacle to continuous-wave operaon is heat dissipation.

The Mizuno diode's oscillation is asciated with tunnelling of carriers from e valence band to the conduction band. scillation frequency increases as the ickness of the junction depletion reon decreases, which corresponds to creased doping.

The mechanism by which it oscillates as yet to be fully explained, but the ew diode can't be classed as a lucky ccident. Hiroyuki Mizuno, who speareaded the development, believed that a illimeter-wave oscillator could be obined with a semiconductor equivalent f a klystron, where high-frequency peration is made possible through elocity modulation of the electron ream.

But Mizuno reasoned it couldn't beone with a transistor. Interaction etween the semiconductor lattice and e current carriers is far greater than e interaction among the carriers themelves in a transistor. For velocity modution effects, "hot" electrons are necesary; their temperature, or speed, is igh enough for carrier-carrier interction to predominate over carrier-late interaction.

In the Mizuno diode, the highly oped pn junction injects "hot" carriers into the bulk semiconductor, where they interact. When an input pulse biases the diode, the carriers tunnel and the diode breaks down, triggering the oscillation. The output pulse lags the input pulse by about one microsecond. For the higher frequencies Mizuno has obtained, breakdown voltage was well below 20 volts, the level where avalanche breakdown begins. In avalanche breakdown, the current carriers collide with lattice electrons and the ionization that results multiplies the number of carriers.

Mizuno's tunneling germanion diode differs in two major respects from Bell Telephone Laboratories' microwave diode (Electronics, Nov. 1, 1965, p. 24). Bell's is silicon and it operates by avalanche breakdown.

These differences Mizuno thinks, may give his diode the edge over silicon microwave diodes. Theoretically, tunneling is less noisy than avalanche breakdown so the signal-to-noise ratio should be inherently higher. Based on experience with transistors, the germanium diodes probably can be pushed to higher frequencies than silicon diodes. The 90GHz top frequency recorded by Mizuno's group was the upper limit of its test gear and not necessarily the diode's.

But with germanium there is a major obstacle—heat dissipation—to overcome before Mizuno's group can achieve continuous wave oscillation. Silicon has better heat conductivity and this makes heat dissipation easier. The Nippon Electric Co., another entrant in the international race to develop a commercial solid state oscillator, already has solved a heat-removal problem with a special cartridge mount for its gallium-arsenide Gunn-effect oscillator.

(The Gunn effect is the emission of coherent microwave oscillations from a bulk semiconductor when an electrical field of a specific magnitude is applied.)

With this achievement, Nippon Electric is only a few months behind two American companies—the International Business Machines Corp. and Bell Telephone Laboratories—and a British concern, Standard Telecommunications Laboratories, an affiliate of the International Telephone and Telegraph Corp.

A solid state oscillator is a particularly attractive goal in Japan, which has the world's heaviest concentration of microwave lines. Nippon Electric supplies 95 per cent of Japan's microwave carrier equipment.

Hiro Marakami, who headed the group that developed the new diodes, says the key development was a cartridge mount with a built-in cavity and improved heat-transfer characteristics. The package allows the dissipation of five watts of input, corresponding to 50 applied volts; in experiments, about 30 volts are supplied, resulting in inputs of slightly more than two watts.

The diodes at Nippon Electric have a centre frequency of about 3GHz with a power output of several milliwatts. The frequency spectrum is less than IMHz. Murakami says the frequency can be varied between 2 and 4GHz, a range of one octave, by adjusting a built-in cavity in the diode mount.

This is higher than the 1GHz delivered by the British experimental oscillator. I.B.M. has predicted it will achieve 9GHz with about 10 milliwatts of continuous-wave power in the next few months.

Heat is a problem because the gallium-arsenide crystals imported from the United States have lower resistivity—by one or two orders of magnitudes—than that of the material with which Bell Labs is working. Because the Gunn effect is a voltage-controlled negative resistance with precise threshold voltage, low resistivity results in high current and the device must be able to dissipate high power without burning up.

Beginning with this issue, ELECTRONICS Australia will use the term Hertz (abbreviated to Hz) instead of cycles per second (cps) as the basic unit of frequency measurement. This will be used with the usual prefixes for multiples, i.e., KHz for kilohertz, MHz for megahertz and GHz for gigahertz.

Nippon Electric says it has achieved pulses at frequencies of more than 10GHz.

The Japanese 3GHz diodes use semiconductor dies 40 microns thick and about 100 microns square. Ohmic contacts are made by evaporating a nickel-tin alloy on to the semiconductor's upper and lower surfaces.

The British oscillator, an epitaxial Gunn-effect device, is built of a substrate or semi-insulating gallium-arsenide about 100 microns thick, on which is grown a layer of pure gallium-arsenide 15 microns thick.

Murakami's immediate goals are amplification and continuous-wave outputs of 100 milliwatts and pulses of 100 watts. At these powers, the Japanese believe that Gunn-effect diodes could replace low-power reflex klystrons; the diodes would even be superior to varactor multipliers for this purpose for two reasons: varactors often suffer from spurious responses, and they tend to become unwieldy when large multiplication ratios are required.

Many other Japanese companies, in addition to Nippon Electric, are working on Gunn-effect oscillators. Several, including the Tokyo Shibaura Electric Co. (Toshiba), Fujitsu, Ltd. and Hitachi, Ltd. have achieved pulse oscillations. ■

# TELEQUIPMENT S51A

## CRT 5″ PDA [3 KV] DC to 3 Mc/s 100 mV/cm.

**PRICE: S51A**
Duty Paid $226.00
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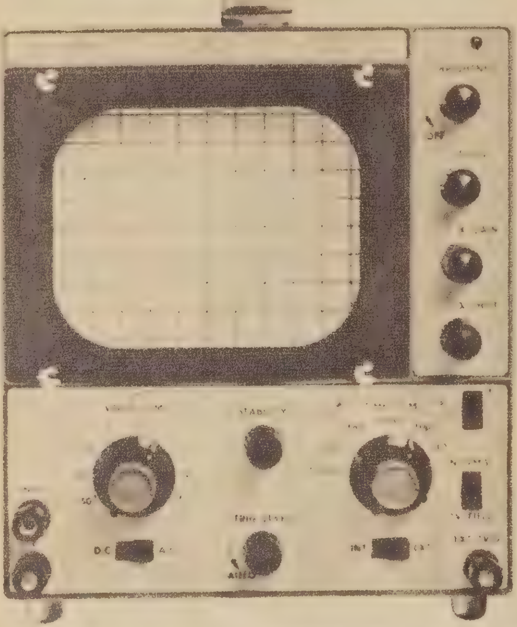


The S51A effectively bridges the gap between large expensive instruments of extreme accuracy and portable oscilloscopes of such limited performance as to be little more than simple indicators. The S51A adequately meets the demand for an economical unit of good performance.

In addition to the S51A itself two other versions of this unit are available.

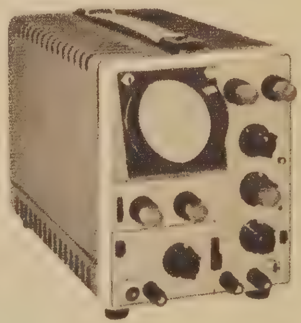
**S51E (Educational Model):** A much simplified and economical unit which is recommended in the Interim Report of the Science Masters' Association and the Nuffield Foundation (U.K.).

**S51T:** Similar to the S51A but is fitted with a switchable additional horizontal amplifier which increases sensitivity to 100 mV/cm with a bandwidth of DC-10Kc/s at -3db.

### S51A SPECIFICATIONS

C.R.T.: 5 in. Flat-faced PDA operating at 3KV.
Y Amplifier: DC-3 Mc/s: 100mV/cm
Attenuator: 100 mV to 50V/cm
Time Base: 6 speeds: 1uS to 100mS/cm
Expansion: Continuously variable
Triggering: Auto-Sync., Selective and TV Sync.
Cooling: Air Thermo-Syphon.

## MODEL 32A SINGLE BEAM SCOPE



**C.R.T.**
3" flatfaced single gun PDA operating at 3.5KV
**Y Amplifier**
DC to 10 Mc/s
100 mV/cm
DC to 1 Mc/s
10 mV/cm
**Rise Time:**
35 nanoseconds

Accurate calibrated input attenuator
Wide Range Calibrated Time Base
18 Pre-set sweep speeds from 1 uSec/cm - 0.5 Sec/cm X Expansion x 10
**Triggering:**
Auto Sync, Selective Built-in TV Sync Separator

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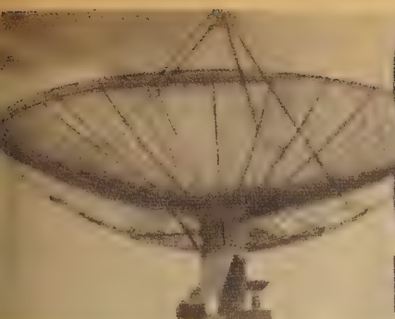


# SCIENTIFIC AND INDUSTRIAL NEWS

## lew system for N.S.W. railways

The mobile radiotelephone network operated by the N.S.W. ailways Department is to be re-equipped with more modern quipment by A.W.A. Work on new installations had already egun, and will continue over the next two-and-a-half years.

The original system, supplied by A.W.A. in 1948 for the epartment's Investigation Branch, was Australia's first V.H.F. M mobile radiotelephone system. The system was augmented in 952, when the present disc-cone aerial, situated close to the lofty agpole at the top of the Harbour Bridge, was erected. The system as been added to and modified over the intervening years, but as become outmoded. It is now used extensively by the Depart- ent, for such applications as expediting construction work, inimising traffic delays and initiating rapid action in the event f rail service breakdowns.

A contract awarded to A.W.A. by the Department provides r the replacement of the greater portion of the present system y the most modern equipment, most of it custom built to the epartment's specifications.

It will be fully duplex, permitting simultaneous two-way ommunication. There will be control equipment at Sydney and awson for operation of repeaters at Glenbrook, Leura, Newnes unction, Cowan, Woy Woy, Sutherland and Chullora. Through e radio-telephone, there will be immediate and selective com- unication between the two control points and to and from obile telephones in road and rail vehicles and portable units. he control points will be able to extend radio calls to and from e departmental manual and automatic telephone networks. All nits will have duplex facilities. In other words, there will be omplete access to and from the main bases and the various "way- de" bases by either radio link or landline, with full monitoring nd supervisory facilities. A total of 85 transistorised duplex quipments will allow the most effective use of mobile road and il vehicles.

## luclear power for water discounted

A report published by the Australian Water Resources Council scounts the value of nuclear power to convert salt water into esh water over the next 20 years. The Minister for National evelopment, Mr D. E. Fairbairn, referred to the report recently the House of Representatives.

He said that a sub-committee of the Water Resources ouncil had looked at the question of desalination very closely. e felt that in the foreseeable future it would be cheaper to otain water in Australia by conventional methods. There would, erhaps, be a need for desalination on a very small scale, but ot on a nuclear scale.

Referring to the possible use of nuclear power for other urposes, Mr Fairbairn said Australia was in the happy position having cheap conventional fuel. Atomic plants were becoming ore competitive, and there was no doubt that in the foreseeable ture there would be areas where nuclear power would be able compete with conventional power, mainly in the North.

## Computer for Munmorah power station

A $700,000 Leeds and Northrup computer has been ordered y Electricity Commission of N.S.W. for Australia's largest power ation, now under construction at Munmorah, on the central oast. The computer, which will make a major contribution to the conomical and efficient operation of the power station, will auto- atically scan some 600 temperature, pressure and other vital eadings, and will give warning if any of these readings vary from re-determined limits. It will also calculate the performance of the plant at frequent intervals, and will indicate any deviation from normal operation.

The computer will service the first two of the station's planned 350MW generators, boilers and associated plant. A second computer will be installed for the third and fourth 350MW units.

## High temperature reactor in U.S.

The first atomic power station in the United States designed to operate at high efficiency steam conditions of around 540 degrees C. has started trial operations. It is at Peach Bottom, Pennsylvania, and is a 40,000 electrical kilowatt plant, deriving its energy from a General Atomic high temperature gas-cooled reactor (H.T.G.R.).

It was built by Philadelphia Electric Company and 52 other electric power companies to demonstrate an advanced concept of nuclear power generation.

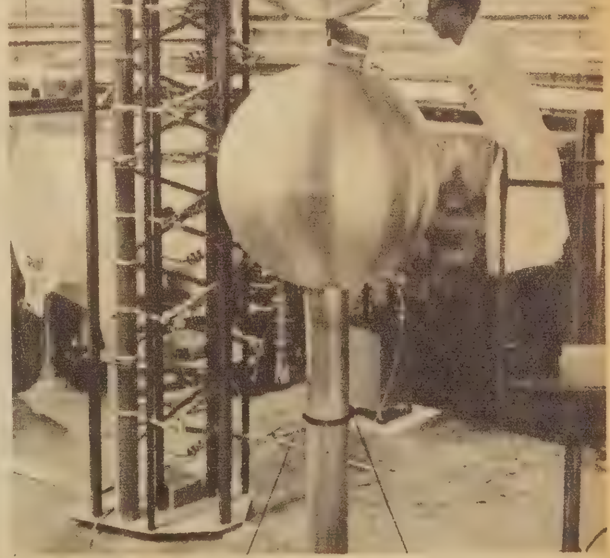
The Peach Bottom plant is a prototype for subsequent, large-sized HTGR plants and is very similar to the Dragon reactor at Winfrith in Britain.

A 330,000 kilowatt HTGR plant will be built for Public Service Company by General Atomic north of Denver, Colorado and will be known as the Fort Saint Vrain Nuclear Generating Station.

## Lightweight klystron from Litton

A new type of power klystron, which the makers say achieves a five-fold reduction in weight and greatly reduced size has been developed in U.S.A. by the Electron Tube Division of Litton Industries, 960 Industrial Road, San Carlos, California.

The tube, which weighs only 80lb ,and has an overall length of 28in, is focused solely by electrostatic fields. This has allowed



*Half a million volts can discharge between these spheres of a Marx impulse generator at the Rutherford Laboratory, a British laboratory centre, set up for research in elementary particle physics and the physics of the nucleus. The generator is used for the study of electrical breakdown in a vacuum, and here an experimental officer is calibrating the gap between the spheres, in preparation for a test.*

NEW FROM
Sansui

# A STEREOPHONIC AMPLIFIER

## *with* AM/FM/SW *tuners and 22 watts total output . .*

## *the model 220*

Here is a high-quality stereophonic amplifier in the classical style — modern in design and electronically superior to most similarly priced amplifiers. Silicon diodes are used in the pre-amplifiers in both channels — hum and noise are thereby reduced to a minimum. Frequency response of the Sansui 220 is 35-20,000 c/s plus or minus 2 db.! Input sensitivity is 3 mV for magnetic pick-ups, Noise and Loudness Controls are standard equipment, Headphone Jack provides personal listening, Treble and Bass Controls enable compensation for all types of recording quality.

Tuner frequency ranges are:— AM 535-1605 Kc/s, FM 88-108 Mc/s, SW 3.5-10 Mc/s. Valves, Transistors and Diodes: 6BM8 x 4, 6AQ8 x 2, 6BE6 x 1, 6BA6 x 3, 12AX7 x 1, 6E5 x 1, 2SC-402 x 2, SE-05a x 2, SE-05-03 x 1, 0A-91 x 3. Both 8 and 16 ohms speaker outputs are provided.

Above all, you should **hear** the new Sansui Model 220. Select the pick-ups and speakers you prefer at your favourite hi-fi store . . . and **listen to your** type of music through the satisfying Sansui 220. Sansui's trend-setting styling blends with any decor — it's conservative, dignified and modern.

You'll be proud to own the new Sansui Model 220; ask for the complete specifications when you visit your hi-fi dealer!

## SANSUI 220

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☐ Interior cabinet surfaces coated
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rovide complete internal sound ab-
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olyutherene lining assures excellent
ass response and freedom from
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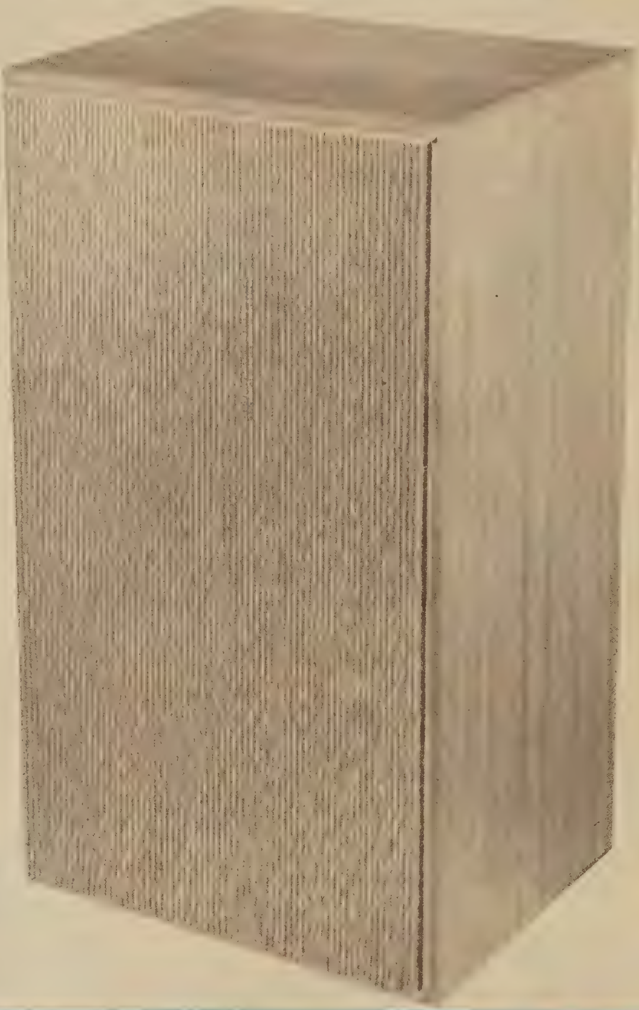

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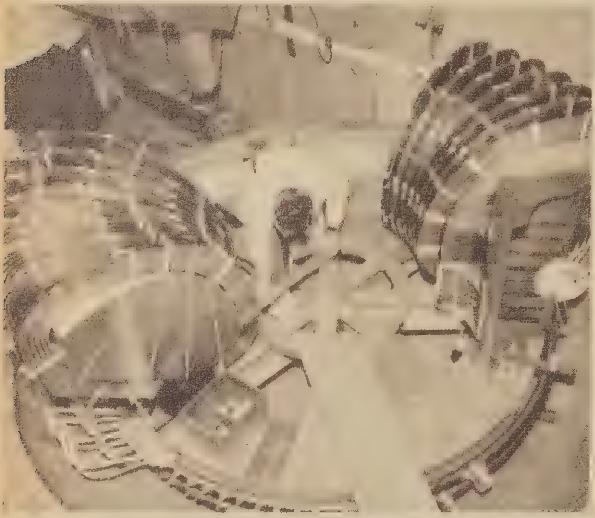
the designers to dispense with external focusing magnets, as well as the associated power supply and cooling system necessary to operate a focusing magnet. Designed for operation at 3GHz, the tube delivers a minimum RF output power of 1MW with a typical efficiency of 45 per cent.

The makers anticipate the new tubes will provide an attractive solution for radar systems requirements such as phased array systems, space and airborne systems, and highly mobile ground-based systems, where the advantages of light weight and compact configuration are specially significant.

## Self-lubricating material

A self-lubricating material called Graflon, which is said to be especially suitable for piston rings, bearings and seals operating under oil-free conditions, has been developed by Morganite Carbon of Battersea Church Road, London, S.W.11. The material is a combination of P.T.F.E. (polytetrafluorethylene) and graphite and it is stated to be resistant to almost all chemicals except very strong acids.

The combination of the two materials, says the company, results in a material with a very high degree of self-lubrication and, for what is virtually a plastics product, a wide operational temperature range of minus 200 degrees C to plus 200 degrees C, or even higher for short periods.



*This technician is aligning the magnet coils for a spectrograph, under construction at the Aldermaston establishment of the U.K. Atomic Energy Commission. The spectrograph, which is destined for research laboratories at Oxford University, will measure the charged particles emitted when a nucleus is bombarded by other charged particles. It will be used in experiments designed to build up information on the atomic structure of materials used in nuclear research.*

Graflon is stated to be less brittle than pure graphite and to resist distortion better than pure P.T.F.E. These characteristics can be varied by altering the proportion of added graphite and by varying the graphite particle size.

## Finishes for aluminium

A range of colour-anodised finishes for architectural aluminium developed by Istituto Sperimentale Metalli Leggeri, via S. Giovanni sul Muro 9, Milan, is being offered for production under licence and under the trade name ACADAL.

Hard, deeply coloured finishes in bronze, grey and gold shades are said to be obtained at moderate current densities and temperatures of 25 to 35 degrees C. Treatment time is 25 to 60 minutes. One of the advantages of the new process, it is stated, is that a cheap electrolyte is used.

The process is more expensive than the usual sulphuric acid processes; it needs more elaborate equipment and requires systematic chemical control. However, this is not regarded as a drawback as the finishes are intended "for sophisticated buildings for which a 10 to 20 per cent increase in cost for architectural metalwork can be afforded."

## "Instant" electric connection

A device for "instant" connection of electric wires to plugs without using screws or screwdrivers is now being marketed by G. E. K. Dennant, Four Trees, Icklington Road, Cobham, Surrey, England.

Called Lacrifix, it consists of a case containing a spring and a metal pear-shaped gripping device. By inserting a pin or paper clip in the hole and depressing the spring, the wire can be placed in the Lacrifix; when the spring is released the connection is firmly made and the more it is pulled the firmer the grip. Short-circuits are said to be eliminated and the device is claimed to be vibration-proof.

## "Umbrella" for factories

An electronic rain detector for use with natural ventilation systems in factories is being introduced by Colt Ventilation and Heating, 15 Langley Road, Surbiton, Surrey, England.

Based on solid-state components, the control is designed to cut ventilating costs in industries where exclusion of rain is essential to quality and production control. In operation, rain falling on an exposed printed circuit detector plate on the factory roof completes a circuit resulting in the automatic closing to "rain stations" of all ventilators in the critical area.

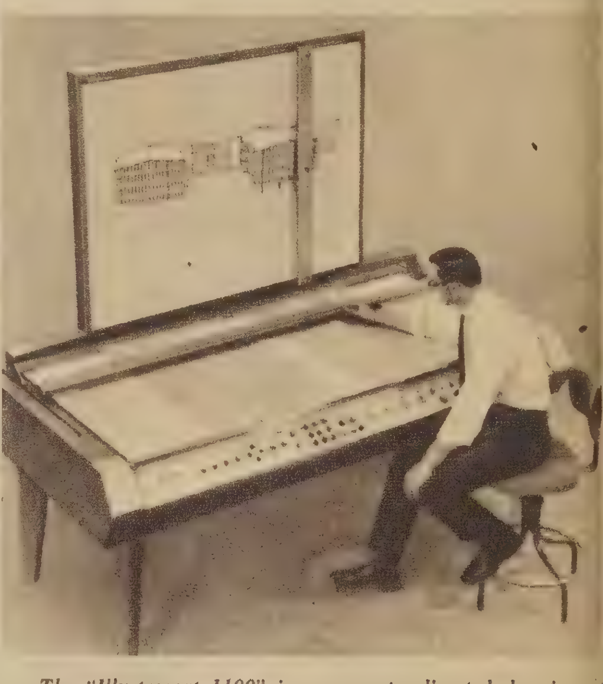
It is designed mainly for pneumatic and motorised systems and allows the use of ventilators with clear opening systems which have wide apertures and unrestricted air flow.

A heater is incorporated in the detector which helps to dry off remaining drops of water on the plate once the rain has stopped. This speeds the opening of the roof ventilators and also overcomes the problems of snow, ice or frost.

## Postal orders sorted automatically

The new postal order now being issued by Australian Post Offices in place of the old post note, has an interesting computer story behind it, according to a report in the June, 1966, issue of "Post Age."

Until July, 1953, the serial numbers of postal notes issued were recorded in registers maintained in the Accounts Branch. Each postal note paid was marked off the register. This system enabled the P.M.G.'s Department to establish whether a particular postal note had been paid, and duplicates could then be issued for notes not marked off the register six months after the last day of the month of issue.



*The "Illustromat 1100" is a computer-directed drawing machine which can create perspective views from two-dimensional drawings. Two styli in the horizontal plane trace blueprint views of the subject. Information thus gained is fed into a computer, which guides an X-Y plotter pen on a vertical surface to create the perspective view. Tilt, rotation and other variants are determined by settings on a simple control panel. The view shown here has been created from an architectural plan.*

The system was discontinued because of the high cost of maintaining the registers. Under the new postal order system, the

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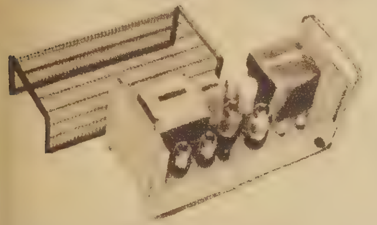
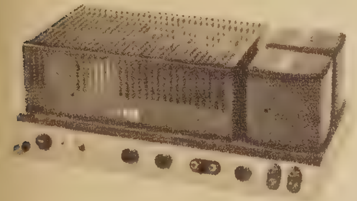


The LUX CORPORATION is regarded as one of Japan's leading electronics manufacturers . . . LUX amplifiers were used in the public address system at the Tokyo Olympics; the NHK Broadcasting Network uses LUX amplifiers. Encel Electronics now proudly offers high quality power amplifiers, both mono and stereo, from the LUX group. The LUX MB8A mono power amplifier may be regarded as an ultimate type valve amplifier, with a rated output of 70 watts and power/frequency response from less than 20 c/s to well over 20.000 c/s. Speaker matching includes 4, 6, 8, 10 and 16 ohms. Valve complement: 2 x 12 AU7, 2 x 6GB8, 2 x 5AR4 Write for complete specifications.



Here is the new LUX KMQ-7 stereo main amplifier which is supplied in a kit set form for the enthusiast to construct . . . output is 40 watts per channel (push-pull 6L6G's), grain oriented silicon steel output transformers are incorporated. Performance is magnificent. Write for full details!

### NEW SYDNEY STORE NOW OPEN!

Encel Electronics' Sydney store is now open . . . conveniently situated on the Ground Floor, 2SM Building, 257 Clarence Street (Tel. No. 29-5160). Here is a veritable Aladdin's Cave of audio equipment, tape recorders, etc. . . . including many exclusive Encel lines not available elsewhere in Sydney. Tel. 29-5160.

# THE NEW ENCEL CSM-40 M.F.B. STEREO AMPLIFIER!

ENCEL
STEREO-PHONIC

The Encel CSM-40 offers more features, more performance, more value—at a lower cost than any comparable unit. Output is over 15 watts RMS in each channel, frequency response is 20-40,000 c/s, input sensitivities are as low as 1.5 mV. Loudness control, rumble filter, scratch filter, separate bass and treble controls, tape monitor, headset jack, motional feedback control and circuits, substantial output transformers . . . all these desirable features are standard equipment on the Encel CSM-40.

The Balance Meter may be switched out of circuit . . .the filaments of the pre-amplifier are DC . . . and the output of the ADC .4 and 10E cartridges will load the CSM-40 and provide excellent results. Price $119. The next shipment is expected to cost $129 to cover increased manufacturing costs. See and hear this outstanding new stereo amplifier at Encel Stereo Centres in Melbourne or in Sydney. Mail orders care-packed and freighted anywhere!

**$119**

**(£59/10/-)**

### CHRYSLER SPEAKER SYSTEMS

Illustrated is the Model CE-2 Chrysler Speaker System. Although it's only 24in x 14in x 12in the CE-2 incorporates a 12in bass unit, two 5in mid-range speakers and two horn type tweeters. Freqeunecy response is 30-20,000 c/s and the complete system is rated at 50 watts (Music Power). Cabinets are walnut. At Encel Stereo Centres the Chrysler CE-2 costs only $119 (£59/10/). **$119**

### BUDGET PRICED STEREO AMPLIFIER

Here is the new COSMOS SW-30C stereo amplifier. Although low in price, the SW-30C has a frequency response of up to 20,000 c/s, an output of 8 watts (push pull 6BM8's) per channel, 4-8-16 ohms speaker matching and many excellent design features. Write for prices and specifications . . . the COSMOS will be another Encel winner!

### NEW MODEL KELLY Mk. V BASS SPEAKER

This new 12in woofer has a basic resonance of 25 c/s and a total flux of 250,000 maxwells with a new magnet assembly. Frequency range is 30-5,000 c/s . . . but crossover is designed for 2500 c/s. Power rating is 35 watts.
Encel price:
$45 (£22/10/).

## NEW PRODUCTS FROM DECCAKELLY

### THE ACOUSTIC LENS

Specially developed for use with the Kelly Ribbon Tweeter, the Acoustic Lens provides optimum dispersion of higher audio frequencies. It is made from high density plastic and fits to the front of the tweeter. Up to 15 kc/s the coverage pattern is constant within 3 db over 150 degrees.
Encel price: $10 (£5).

### NEW 15" WOOFER SPEAKER (Mk. VII)

This new Kelly speaker is rated at 50 watts — cone resonance is 20 c/s. Frequency response is 30-5,000 c/s — total flux 350,000 maxwells. Recommended crossover frequency is 2,500 c/s. The Mk. VII uses a laminated aluminium former with the voice coil embedded in polyester resin — the metal core acts as a heat sink allowing larger power outputs than normal. Guitar models also available at the same price.
Encel price:
$55 (£27/10/)
Kelly cross-over networks at 2,500 c/s.
$11 (£5/10/).

### THE KELLY Mk. II RIBBON TWEETER

Regarded as the most advanced tweeter available for domestic speaker systems, the Mk. II Kelly Ribbon is more popular than ever at the Encel price of only $39. HF dispersion may be widened with the Acoustic Lens .. .. .. .. .. .. **$39**

# Encel Electronics Pty. Ltd.

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Reference to individual data sheets is advisable when approaching maximum limiting values, either electrically or thermally. You are invited to write to the Mullard Technical Service Departments for more detailed information.

| Type Number | Description and Application | $-V_{CB}$ max (V) | $-V_{CE}$ max (V) | $-V_{EB}$ max (V) | $-I_C$ max (mA) | $-I_B$ max (mA) | $T_j$ max (°C) | $P_{tot}$ max $T_{amb}$ 25°C (mW) |
|---|---|---|---|---|---|---|---|---|
| **AC125** | General purpose audio pre-amplifier and driver of the p-n-p alloy junction type | 32 | 32 | 10 | 200 | 10 | 90 ■ | 500 ● |
| **AC126** | High gain audio pre-amplifier and driver of the p-n-p alloy junction type | 32 | 32 | 10 | 200 | 10 | 90 ■ | 500 ● |
| **AC127** | **n-p-n** germanium alloy junction transistor for use with AC128 or AC132 in complementary Class 'B' output stages | +32 | +32 | +10 | 500 | 15 | 100 ■ | 400 ● |
| **AC128**<br>**2-AC128** | High gain germanium alloy junction transistor of the p-n-p type designed for use in Class 'B' output stages | 32 | 32 | 10 | 1A | 40 | 90 ■ | 700 ● |
| **AC132**<br>**2-AC132** | Germanium alloy junction transistor of the p-n-p type for use in complementary Class 'B' output stages | 32 | 32 | 10 | 200 | 10 | 90 ■ | 550 ● |
| **AC172** | **n-p-n** low noise junction transistor of the germanium alloy type intended for use as audio pre-amplifier | +32 | +32 | +10 | 10★ | 10 | 100 ■ | 280 ● |
| **AD149**<br>**2-AD149** | Power junction transistor of the p-n-p germanium alloy type for use in audio output stages | 50 | 50 | 20 | 3·5A | 500 | 110 ■ | 22.5W ● |
| **AF114N** | Germanium transistor of the p-n-p alloy diffused type designed for use up to 100Mc/s | 32 | 32 | — | 10 | 1 | 75 | 50 ▼ |
| **AF115N** | Germanium transistor of the p-n-p alloy diffused type designed for use up to 100Mc/s as mixer/oscillator and for use as RF amplifier up to 27Mc/s | 32 | 32 | — | 10 | 1 | 75 | 50 ▼ |
| **AF116N** | Germanium transistor of the p-n-p alloy diffused type designed for use as mixer/oscillator and RF amplifier up to 16 Mc/s | 32 | 32 | — | 10 | 1 | 75 | 50 ▼ |
| **AF117N** | Germanium transistor of the p-n-p alloy diffused type designed for use as mixer/oscillator and RF amplifier up to 6Mc/s | 32 | 32 | — | 10 | 1 | 75 | 50 ▼ |
| **BC107** | **n-p-n** silicon planar epitaxial high voltage transistor primarily intended for audio applications. | +45 | +45 | +5 | 100 | — | 175 | 300 |
| **BC108** | **n-p-n** silicon planar epitaxial general purpose transistor primarily intended for audio applications. | +20 | +20 | +5 | 100 | — | 175 | 300 |
| **BC109** | **n-p-n** silicon planar epitaxial low noise transistor primarily intended for audio applications | +20 | +20 | +5 | 100 | — | 175 | 300 |
| **BF115** | **n-p-n** silicon planar epitaxial high frequency transistor primarily intended for RF amplifiers and mixer/oscillators ($f_T = 230$Mc/s) | +50 | +30 | +5 | 30 | — | 175 | 140 ▼ |
| **OC44N** | Low noise junction transistor of the p-n-p germanium alloy type for use in early stages of audio amplifiers and as mixer/oscillator in broadcast receivers | 15 | 15 | 12 | 10 | 1 | 90 ■ | 43 ▼ |
| **OC45N** | Low noise junction transistor of the p-n-p germanium alloy type intended for use in early stages of audio amplifiers and in IF stages in broadcast receivers | 15 | 15 | 12 | 10 | 1 | 90 ■ | 43 ▼ |
| **OC74N**<br>**2-OC74N** | High gain germanium alloy junction transistor of the p-n-p type designed for use in Class 'B' output stages | 20 | 20 | 6 | 300 | — | 90 ■ | 550 ● |

▼ $T_{amb} = 45$°C ■ 200 hours operation ● with suitable heat sink ★ Typical

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epartment will again be able to confirm payment and issue uplicates of orders unpaid after six months.

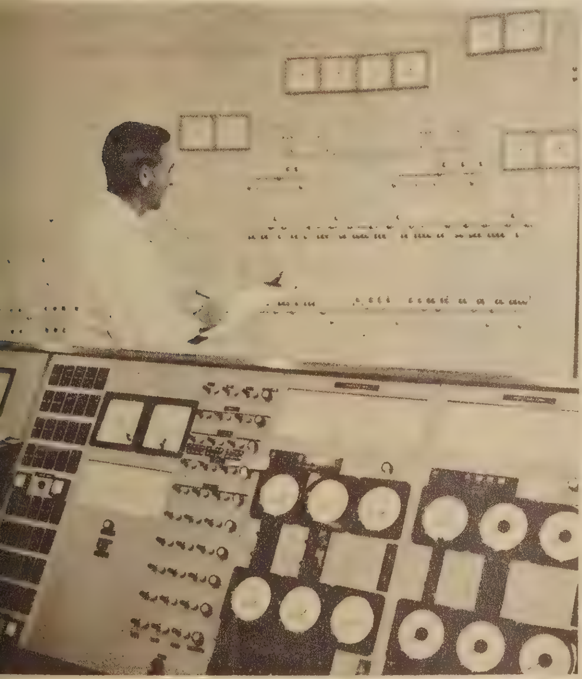
Electronic sorters operating on the magnetic ink character ecognition (M.I.C.R.) technique will sort paid postal orders into tate, denomination and serial number so that any particular paid ostal order can be located provided the serial number is known. Vhen an application for a duplicate order is received, the paid rders can be readily searched to confirm that payment has not lready been made before a duplicate is issued.

The electronic sorters can sort up to 1,500 orders a minute, ut a number of passes through the sorter are needed to complete ne sorting process. For instance, the first pass separates the rders into States, the second into denomination, the third sorts ne first figure of serial number, and so on.

Only two electronic sorters are needed to sort all the postal rders paid in Australia and Papua-New Guinea. One will be ocated in Sydney and the other in Melbourne. The Sydney achine will sort paid orders from New South Wales, Queensland, nd Papua-New Guinea. The Melbourne machine will sort orders om Victoria, South Australia, Western Australia, and Tasmania.

The machines will also sort paid money orders to assist in airing the orders with the relative money order debit notes.

The new postal orders have been designed in modern format, ith the accent on simplicity. Also, because of the requirements the electronic sorters, the paper they are printed on is thicker an that used for postal notes.



*A system controller records voltage and current readings at a section of the large mosaic diagram which is a feature of the control room facilities supplied and installed by the Plessey Automation Group at the Sydney South Control Centre of the Electricity Commission of N.S.W. Plessey Automation Group has also received a contract for the supply of supervisory remote control equipment and communications equipment for the Commission's new power stations at Vales Point, Wangi and Munmorah, all situated on the northern coalfields of N.S.W.*

As the banks will handle considerable numbers of the orders, All Bank's Automation Committee was consulted on the sign of the orders so that the order forms would be suitable processing on the magnetic ink equipment used by the banks.

## ombined blowtorch and soldering iron

A combined blowtorch and soldering iron, the Flamidor, is a rsatile tool for all forms of heat application, such as hard and ft soldering, and glass drawing.

Basis of the unit is a pocket size butane gas cylinder on to hich a conical cap, complete with blowtorch nozzle, is screwed. The valve in the top of the cylinder is operated by screwing the cap down. In this form the Flamidor can be used for soldering and other operations requiring an intense, slim flame. A copper bit, mounted in a special clamp and fitted over the nozzle, converts the tool into a soldering iron.

It can be used at any angle, but only after burning for one minute in an upright position, and is available from Henri Picard and Frere, 34-35 Furnival Street, London, E.C.4. Duration of flame per cylinder is about four hours.

## Hardening paint by radiation

Paint hardened by radiation instead of heat is already in use in U.S.A. on plywood panels and will soon be used for car components, says the Ford Motor Company, of American Road, Dearborn, Michigan.

The paint, which is cured by a beam of electrons, is particularly suitable for materials that cannot stand heat, such as wood, rubber and plastics. The electron beam is moved across the surface to be dried by controls like those in a television receiver. Ford licensed Boise Cascade Corporation to apply the process to plywood and particle board for exterior use.

## I.R.E.E. Australian officers

Mr A. W. de Courcy Browne, O.B.E., F.I.R.E.E. (Aust.) has been elected President of the Institute of Radio and Electronics Engineers Australia for 1966-67. Mr de Courcy Browne was Deputy Director of Signals, Australian Army Staff Corps, from 1953 to 1957. He was awarded the O.B.E. in 1956 for his services as design and supervisory engineer of the Australian Military Forces Communication Systems. He is now on the staff of Amalgamated Wireless (Australasia) Ltd.

Deputy President of the Institution is Mr H. R. Wiltshire. Vice-Presidents are Professor R. M. Huey and Mr V. F. Kenna.

I.R.E.E. Australia has also announced the election to membership of four prominent Australians, each of whom has, in his own field, contributed greatly to the advance of communications and electronic engineering in this country.

They are: The Hon. Allen Fairhall, M.P., Minister for Defence; Sir Charles Davidson, K.B.E., who was Postmaster-General from 1956 to 1963; Sir James Kirby, C.B.E., a prominent Sydney industrialist; and Mr Charles Carson, managing director of Broadcasters (Aust.) Pty. Ltd., who has also been president of the Federation of Australian Commercial Broadcasters on three occasions.

*In the workshops of Marconi Microelectronics Ltd., at Witham, Essex, U.K., these operators are operating bonding machines to attach microcircuits to their protective cans, and welding contacts with gold wire only one thousandth of an inch in diameter. Marconi Microelectronics is now in full scale production with both linear and digital microcircuits. The bonding machines seen in the picture were designed and built in the company's own factory.*

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## Australian Trade Fair

A permanent Australian Trade Fair is to e established in Surfer's Paradise later this ear. It will be constructed on a six-acre ite on the banks of the Nerang River, due vest of the town. Total cost of the project, o be built over a period of two years, will e about one million dollars.

The fair is designed to serve a twofold urpose, as both a trade stimulant and najor tourist attraction. In addition to trade xhibits, ranging from heavy machinery to lomestic appliances, special demonstrations nd shows are planned for the fair throughout the year. These will include trade exhibitions, conferences, fashion shows and porting attractions staged in a specially lesigned open-air arena and auditorium.

## Single-handed soldering

A soldering iron shaped like a pistol and perable with one hand is the subject of a atent taken out by Motoyuki Koga, of 66 4-chome Shimo Meguro, Meguroku, Tokyo, Japan. A strip of solder fed from a eel passes through the gun, and after nelting is applied directly to the joint to be ealed.

The gun uses metallic and polyamide esin solders and because the solder is not nelted inside the gun, but as it emerges rom the end of the barrel, no residual older is left in it after use.

## Measuring small radiation

Chemical dosimeters which will measure ery small amounts of radiation are available for royalty-free licensing from the American Atomic Energy Commission, Patents Office, Washington D.C. 20545.

The dosimeter is a two-part electrical cell eparated by a sintered glass partition. One ection contains a gold electrode in ferrous ulphate, the other platinum in sulphuric acid. A galvanometer between electrodes neasures the current produced.

When the cell is subject to radiation, the xidation of ferrous to ferric sulphate speeds up and increases the current flowing.

*This new radiotelephone, little bigger than a pocket diary, is claimed by the makers (Rank Bush Murphy Ltd., of U.K.) to be the smallest single unit type in the world. It is designed to fit into the top pocket of a tunic, since most users will be wearing uniform, e.g., police, firemen, ambulance men and other officials. Any one of four VHF channels can be used for person-to-person or person-to-base communication. Dimensions, including clip-on battery, are 5 3/16 x 3¾ x 13/16in.*

*Illustrated is the latest addition to the KLIXON 10AT2 series of miniature hermetically-sealed snap-action switches, which has a current rating of 7A, compared with a previous maximum rating of 3A. The makers, Metals and Controls Inc. (a corporate division of Texas Instruments Inc.) claim these switches are the smallest of their type in the world. Technical data is available from Texas Instruments Australia Ltd., Oldham Road, Elizabeth, S.A.*

## Applying thin coating

Ultra-thin plastic coatings, only a few molecules thick, can be applied in the Glofilm process developed by Radiation Research Corp., of 1150 Shames Drive, West bury, New York.

The plastic material is gasified and the gas particles ionised so they will settle on the surface to be coated. When the plastic has condensed on the surface, it is cured to make a stable film.

## Plastic window system

A glass-reinforced plastic window system is to be marketed by Bovis Building Products, Newcombe House, Notting Hill Gate, London, W.11.

It comprises a series of specially designed sections, tubular in form, capable of being assembled in a variety of ways to give a complete window range, including monumental and domestic windows, curtain and window walling, pivot sashes, vent lights and side-hung casements. The sections are made so that unsightly control systems for special fittings such as venetian blinds and fixed vents may be hidden within them, leaving an entirely free exterior.

## Motorised roller skates

Pairs of roller skates, one of which has a small motor built into it, plus cable controls like a motor cycle, and the other is very much like an ordinary roller skate, but with much more robust construction, may well make useful vehicles according to the inventor, Franz Kohel, 5a, Ottokarstrasse, Berlin-Tempelhof.

The skates are strapped on and the controls of the motorised one—a cable with startor, brake and accelerator lever—held in the hand. Steering is accomplished by using the unpowered skate.

## Spinning off solder

Circuit boards can be given a smooth, even pre-coating of solder by spinning them after dipping, claims Gyrex Corporation, of 3,003, Penn Street, Santa Monica, California. A touch of a soldering iron and wire anywhere on the board then makes the connection. The spinning device will handle boards up to 12 by 12 inches at a rate of 100 an hour. ▪

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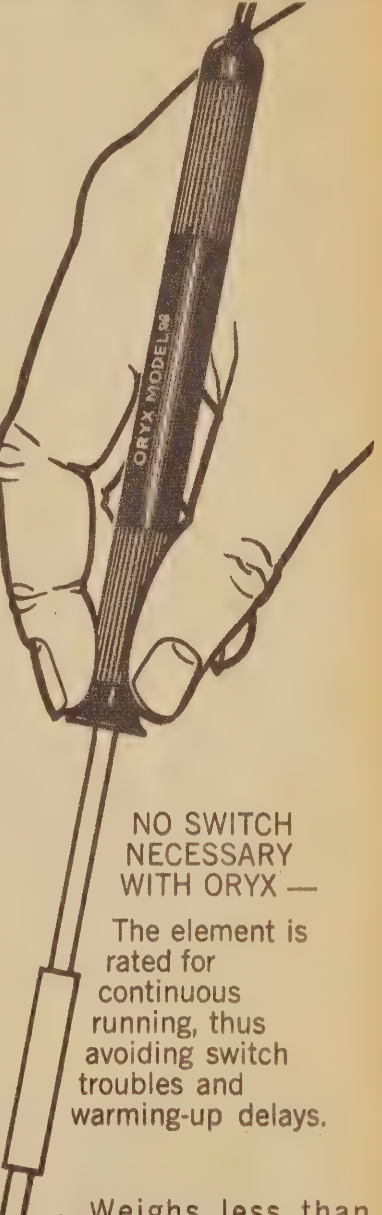

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## Logic and counting circuits — 3

# COUNTING and NUMBER systems

Counting and scaling — two general types of counting circuitry — the gas-filled counter tube — the vacuum counter tube or "trochotron" — numerical notation systems the binary system — BCD codes — fixed and variable weighting — the reflected binary code — redundancy and error detection.

### by Jamieson Rowe

In a great many applications of digital techniques, circuitry is required to perform the operation of counting—usually, counting a series of electrical pulses. The pulses may be occurring randomly as in cases where they originate from a radiation detector such as a Geiger-Muller tube or where they correspond to physical articles on a conveyor belt interrupting a light beam; or, alternatively, they may be occurring periodically, as from an electronic or other oscillator.

The operation "counting" as used in electronics should be carefully differentiated from "addition," although quite often in digital equipment the circuitry used to perform these two operations may be somewhat similar.

Whereas **counting** is the operation of responding to a series of pulses and registering the number of these received, **addition** is the operation where the digital representations of two numbers are used to produce the representation of their arithmetical sum. Addition is one of a number of digital operations normally called "arithmetic," and as such is rather outside the scope of the present series of articles.

Another operation which should be differentiated from counting as such as "scaling." Here the connection between the two is much closer than between counting and addition, because in general exactly the same circuitry is used for scaling as for counting. The difference between scaling and counting is in terms of the interpretation placed on circuit operation.

In counting, the "output" of the circuitry is understood to be continuously available as a registration of the number of input pulses which have occurred up to the time concerned. In **scaling,** the circuitry is arranged to deliver an output pulse only after each successive occurrence of a given number of input pulses; it may be arranged to deliver an output pulse for every 5 input pulses, every 16 input pulses, or so on.

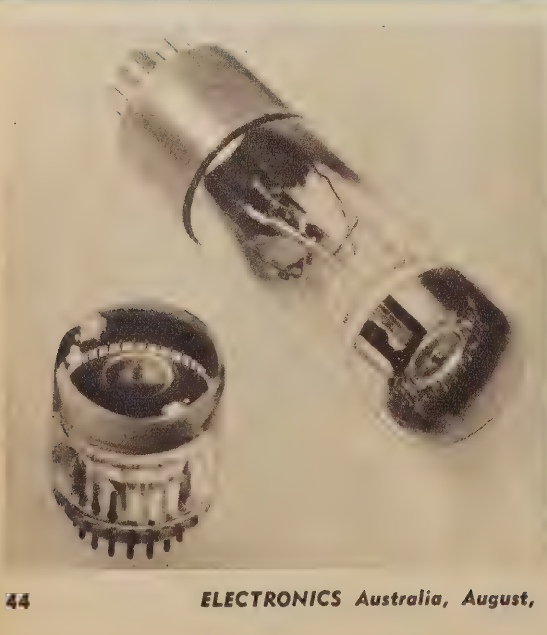
Where the input pulses are derived from an oscillator and are periodic in nature, scaling amounts to **frequency division** because the output of the scaler will also be periodic and will have a period corresponding to the designated number of input periods. Thus for periodic signals a scale-of-16 scaler becomes a × 16 frequency divider, etc.

The many applications of counting circuitry **as such** include digital-analog and analog-digital information conversion, sequential control of digital co-puter operations as directed by a 'p-gram," and such digital instruments s voltmeters, frequency- and time peri-meters, thermometers and freque y synthesisers. Some of these may e discussed in a later article of this sers.

Counting circuits can be divided c-veniently into two general types; the whose operation is based upon the e of circuit elements of a bi-stable natu, such as valve or transistor "flip-flop" and those whose operation is **not** ba d upon such elements. The latter type f counting circuitry is usually arranged o count directly in familiar decimal nu-eral notation, whereas special arran-ments are often required if the forr r type is to count in this fashion. U-ally it is arranged to perform the bac counting operation in binary notati, as will be discussed later in this artie and in the following article.

Two examples of counting circuiy which do not depend upon bi-sta circuit elements will now be discuss. These are the circuits associated wi the multi-cathode gas-filled counter tu or **"Dekatron"** (this word is actually a registered trade-mark of Ericsson Te-phones Limited, but is commonly us to describe any tube of this gene type) and those associated with vacuum-type counter tube or **trochotr**.

Gas-filled counter tubes usually ha a construction as shown in figure 1. central disc anode is surrounded by so 30 rod electrodes spaced equidistan around its periphery. Every third r electrode is termed a "cathode," and but one of these cathodes are connect together ($K_{1-9}$). The remaining cathode brought out to a separate electrode (K



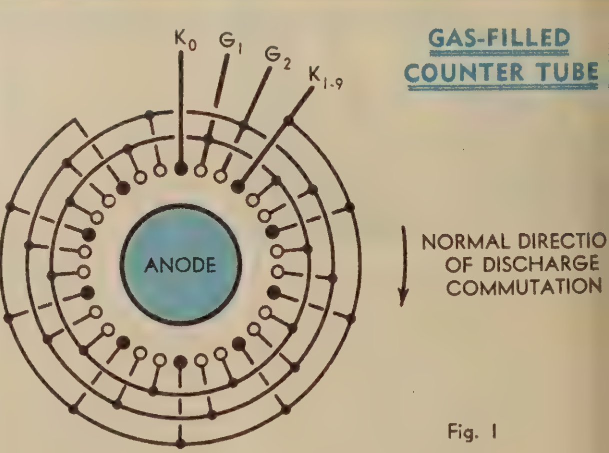
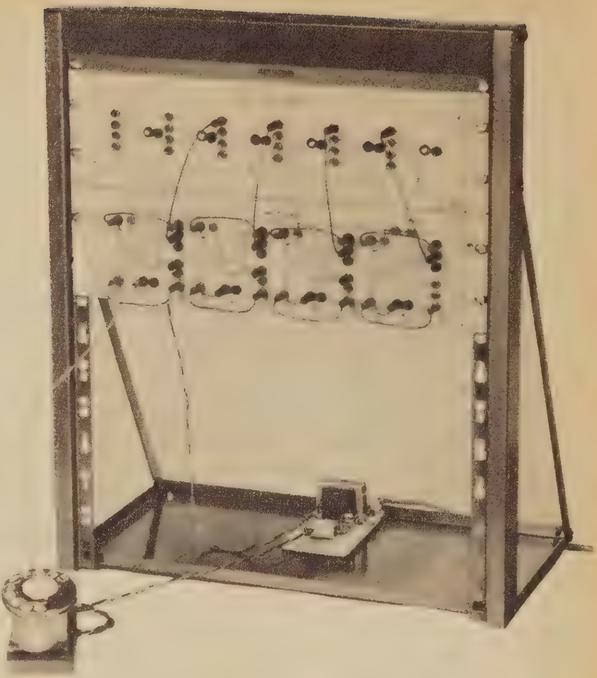


Fig. 1

*The larger of the two "Dekatron" gas-filled tubes shown at left is a counter tube; the smaller is a selector tube. (Both courtesy Ducon Division, Plessey Components Group. "Dekatron" is a registered trade mark.)*

*In the next article in this series the discussion of counting and number systems is continued wth an explanation of "flip-flop" bi-stable elements and their use in binary counting; the discussion concludes with the description of a second panel for the digital demonstrator unit. Shown here is the partly-completed demonstrator with the two panels set up for counting pulses from a telephone dial.*



The rod electrodes immediately clock-ise from each of the cathodes are all onnected together, being called the first guide electrodes" (G1). Similarly, ne remaining electrodes are connected ogether to form the "second guide elecrodes" (G2). The complete electrode ssembly is mounted in a neon-filled lass bulb which is arranged so that any ischarge between the anode and other lectrodes may be observed visually.

The operation of this tube as a counter nay be explained by reference to figure . The anode is connected to a positive upply voltage Vbb (usually about 400V) ia a load resistor R1, while the cathdes are taken to earth—via a normally losed push button in the case of $K_{1-9}$, nd either directly or via a small resisor in the case of $K_0$.

The guide electrodes G1 and G2 are onnected to a source of positive voltage 'c (usually about 40V) to ensure that nder steady-state conditions they do ot act as cathodes. They are also iner-connected and AC coupled to the nput terminal—G1 directly via a DC locking capacitor only, and G2 via n integrating network formed by reistor R and capacitor C.

When voltage is applied to the circuit, ushing the reset button disconnects athodes 1-9 from earth, leaving $K_0$ as ne most negative of all the rod elecrodes. A discharge thus occurs between nis cathode and the anode, the current rawn lowering the anode voltage to a alue determined by the **maintaining** oltage of the discharge. As this is ower than the **ignition** voltage of the emaining cathodes, the button may then e released without transferring the disharge away from $K_0$.

Consider now what happens when a **negative - going** pulse is applied to the input terminal, with an amplitude sufficient to temporarily cancel the positive bias on the G1 electrodes and drive them negative with respect to earth. When this occurs the A-G1 voltage will approach the ignition voltage; and as the G1 electrode nearest $K_0$ is in a region which is partially ionised, its ignition level will be least negative with respect to the anode. Thus, as soon as this voltage is reached the tube discharge will transfer from $K_0$ to this G1 electrode.

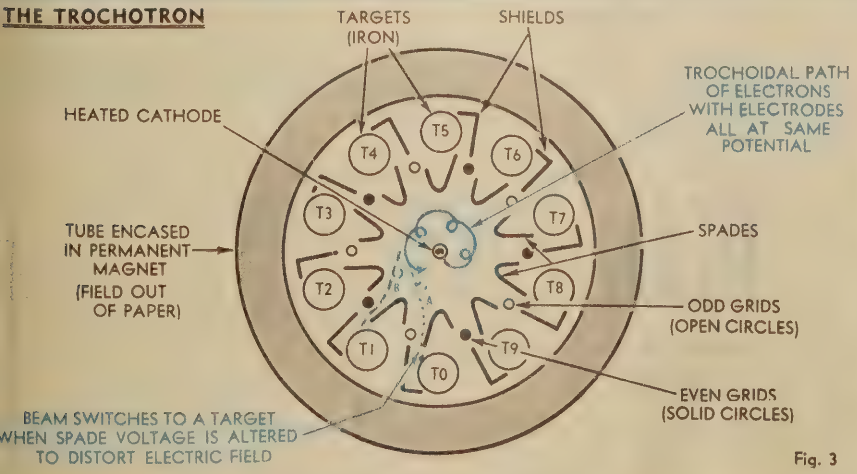
Now the input pulse lasts for only a short time, and when it ceases the G1 electrodes return to the positive potential Vc. If there were no G2 electrodes the discharge would simply return to $K_0$ when this occurred. However, there **are** G2 electrodes, and the integrating circuit formed by R and C has the effect of supplying these electrodes with a delayed version of the input pluse.

The integrating constants R and C are, in fact, so arranged that, at the very instant that the G1 electrodes return to the positive bias voltage, the G2 electrodes have just reached the voltage where the G2 electrode nearest the conducting G1 electrode is at its ignition voltage. Again, this G2 electrode will have the least negative ignition of all G2 electrodes because it is in a region of partial ionisation. Thus, the discharge will not return to $K_0$ but will transfer from G1 to G2.

When, in turn, the pulse on the G2 electrodes decays, the discharge cannot return to the G1 electrode from whence it came because this has returned to the positive voltage Vc. Instead, it transfers to the most negative electrode in the vicinity, which is also the electrode with the least negative ignition voltage—$K_1$. And it will remain on this cathode until another pulse appears at the input to initiate a second transfer cycle.

It may be seen that the single negative input pulse has resulted in a stable transfer of the tube discharge from one cathode to the next. In identical fashion, further input pulses will transfer the discharge around to the other cathodes in turn.

The tenth pulse will return the discharge to $K_0$; and if a resistor (shown


THE TROCHOTRON
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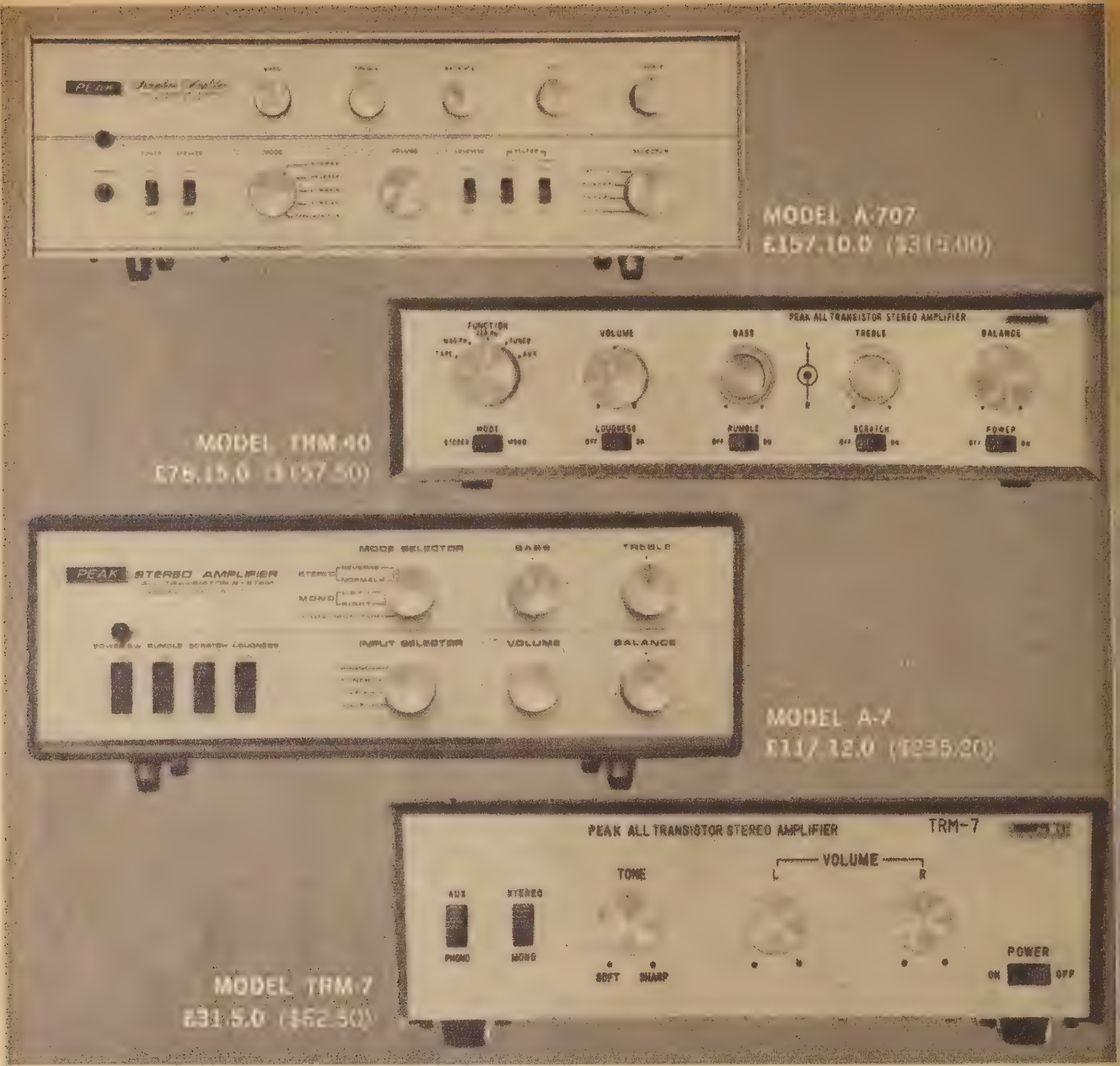
T1
T2
T3
T4
T5
T6
T7
T8
T9
B
A
TUBE ENCASED IN PERMANENT MAGNET (FIELD OUT OF PAPER)
SPADES
ODD GRIDS (OPEN CIRCLES)
EVEN GRIDS (SOLID CIRCLES)
BEAM SWITCHES TO A TARGET WHEN SPADE VOLTAGE IS ALTERED TO DISTORT ELECTRIC FIELD

Fig. 3

*The tube at right is a trochotron high-speed vacuum counting tube, capable of operating at counting speeds up to IMHz. (Courtesy Mullard-Australia Ltd.)*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hed) is fitted in series with this cath- a positive pulse wll be generated for ssible use in feeding a "tens" counting cuit. As far as this stage is con- ned, however, the discharge will con- ue to commutate from one cathode to other for each successive input pulse.

Read-out of the count registered by tube may be performed at any time nply by looking into the tube to see ich cathode is currently associated th the discharge—or, at least, this be done when the tube is counting rly slowly. When rapid counting is curring it may not be possible to see ich cathode is associated with the charge glow.

And although the gas-filled counter e is not capable of counting at par- ularly high speeds, the maximum eed is about 20KHz—rather too high visual read-out while in operation! with all counters, however, the read- t may be made whenever the input lses slow down or cease temporarily.

The gas-filled counter tube may be ed for scaling, as one might imagine. en the tube shown in figures 1 and may be used in this fashion, as the istor from $K_0$ to earth provides an tput for every 10 input pulses. How- er, for scaling purposes it is usual employ a variation of the basic tube sign in which other cathodes besides are brought out to separate connec- ns. In some cases all 10 of the cath- es are given separate connections, in ich case the tube is called a "selec- " tube.

Finally, it may be noted that the gas- led tube may be made to count in re- rse simply by interchanging the con- ctions to the G1 and G2 electrodes.

The major disadvantage of the gas- led counter tube is that its counting eed is limited. Where counting must performed at speeds higher than out 20KHz the de-ionisation time of e gas filling makes operation unreli- le.

A vacuum-type counter tube which is pable of operating to about 2MHz is e **trochotron,** also called the "beam- itching tube" or the "beam-X switch." lthough this tube is somewhat different om and more complex in its operation an the gas-filled counter tube, there e certain similarities which should be- me apparent from the following de- ription.

Figure 3 shows the construction of a pical trochotron. In an evacuated en- lope which is surrounded by an annu- r permanent magnet are ten cylindri- l iron electrodes which act both as ides for the magnetic field and as arget" electrodes. The magnetic field ithin the tube may be visualised as rallel to the axis of the tube and nerging perpendicularly from the plane the diagram. (In some versions of the ochotron there is no external magnet, t the target electrodes are themselves agnets.)

At the centre of the tube axis is a nventional heated cathode. Interposed tween this cathode and each target ectrode are ten "J"-shaped electrodes rmed "spades," and adjacent to the ades wire electrodes termed "grids." nlly a set of "L"-shaped electrodes e included between the targets to act electrical shields.

The shield electrodes are all connected gether; while alternate grids are con- cted together to form two groups of ve (shown as open and solid circles on e diagram, for clarity) termed the odd" and "even" grids. All spades and targets are given individual connections.

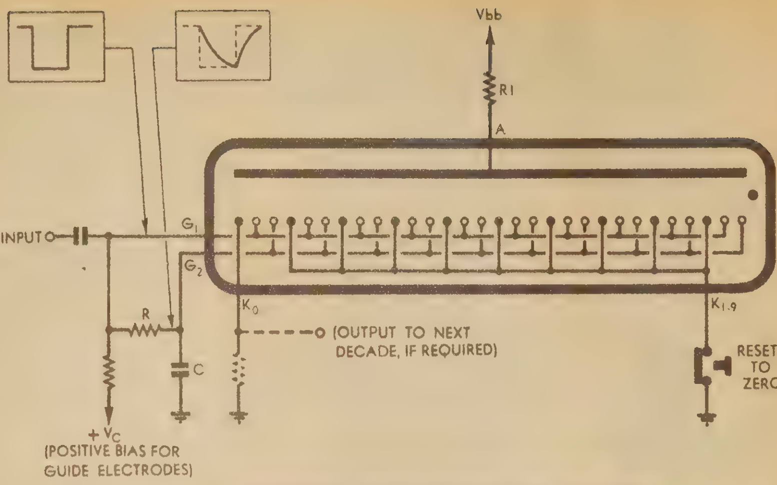
Vbb
R1
A
INPUT
G1
G2
R
C
K0
OUTPUT TO NEXT DECADE, IF REQUIRED)
K1-9
RESET TO ZERO
+VC
(POSITIVE BIAS FOR GUIDE ELECTRODES)

Fig. 2

OPERATION OF GAS-FILLED COUNTER TUBE

*The basic circuit of a pulse-counting stage using a gas-filled counting tube of the type shown on page 44. By feeding each input pulse sequentially to the two guide electrode systems, the cathode discharge is switched.*

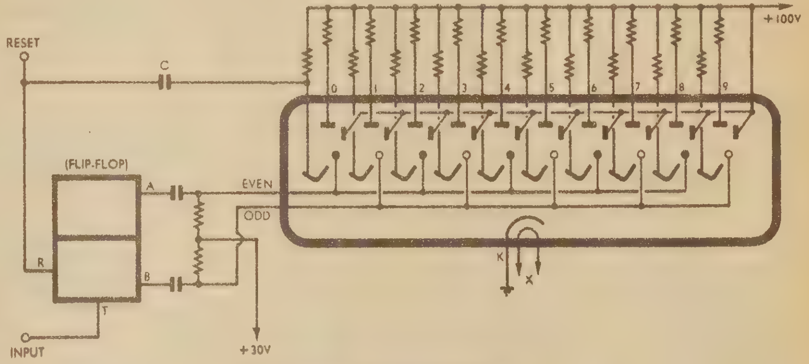

Fig. 4

OPERATION OF THE TROCHOTRON

*The basic circuit of a counting stage using the trochotron vacuum counting tube. Input pulses initiate negative-going pulses alternatively at the "even" and "odd" grid electrodes, switching the electron beam.*

In operation the shield electrodes are connected to a positive voltage supply (usually about 100V). The targets are connected to the same supply via low-value resistors, while the spades also connect to the supply via high-value resistors. The cathode is earthed, and the grid systems connected to a positive bias supply (about 30V) via suitable resistors. Figure 4 shows the general circuit configuration.

The tube is arranged so that with the correct operating voltages applied to the electrodes at switch-on, the magnetic and electric fields adjacent to the cathode are such that on leaving the cathode electrons do not move to any of the positive electrodes but spiral around the cathode in paths corresponding to the mathematical **trochoid** curve.

They do not proceed to the positive electrodes because the latter are all at the same voltage, resulting in a completely uniform radial electric field; the electrons are "trapped" into rotating around the cathode under the influence of the magnetic field, oscillating away from and toward the cathode under the combined influence of both fields.

To cause the tube to register "0" the electron beam must be guided into moving to Target $T_0$. This is done by applying a negative-going pulse to the "reset" terminal in figure 4, the pulse having an amplitude of approximately 35V. One of the effects of this is to apply the pulse to the "0" spade electrode, temporarily lowering the voltage on this electrode to earth potential or beyond.

With spade "0" at earth potential the electric field within the tube is distorted in such a way that the electron beam is deflected from its circular path to glance past spade 0 and be collected by target $T_0$. Although most of the electrons are collected by $T_0$, sufficient are collected by spade 0 to maintain the low voltage on this electrode due to voltage drop in the supply resistor. When the reset pulse ends, the beam thus remains in its new position, virtually "locking" itself to $T_0$ by maintaining the low voltage on spade 0.

To explain how the tube performs counting, reference must be made to the flip-flop unit shown capacitively coupled to the two grid systems and connected to the reset terminal.

The flip-flop will be discussed in some detail in the next article in this series and it is not proposed to explain its operation here. For the present, it will be sufficient to regard it as a device which responds to pulses applied to the input terminal by providing negative pulses alternatively to outputs A and B. The

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†Sensitivity : −52 dB±3 dB,
Dimensions : 148×48×34.5 mm without stand
Cable : 4 ϕmm, 3 m
Weight : 1¼ lbs (525 g)

### DF-1DE

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 150~10,000 c/s±8 dB
†Sensitivity : −57 dB±3 dB,
Dimensions : 385.5 mm high
21 mm diameter, microphone
128 mm diameter, stand
Cable : 4 ϕmm, 1.5 m
Weight : 1⅝ lbs (840 g) with cable

### *DF-14B

SPECIFICATIONS
Impedance : 50 kΩ Variable
Frequency Response : 100~10,000 c/s±8 dB
†Sensitivity : −48 dB±3 dB,
Dimensions : 136×75×47 mm
Cable : 6 ϕmm, 4 m
Weight : 2 lbs (900 g)

### *DF-22B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 50~12,000 c/s±7 dB
†Sensitivity : −57 dB±3 dB,
Dimensions : 32.5 mm diameter, 220 mm long
Cable : 6 ϕmm, 4 m
Weight : 1¼ lbs (575 g)

### DF-1/*DF-1B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 100~10,000 c/s±8
†Sensitivity : −57 dB±3 dB,
Dimensions : 21 mm diameter, 82.7 mm lo
Cable : 3 ϕmm, 1.5 m
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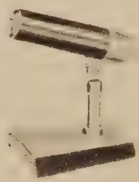
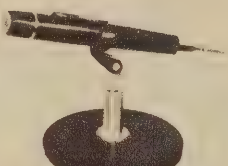


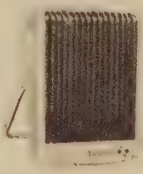
### DF-3

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 50~12,000 c/s±8 dB
†Sensitivity : −56 dB±3 dB,
Dimensions : 33.5 mm diameter, 133 mm lg
Cable : 4 ϕmm, 1.5 m
Weight : 9.0 oz (255 g) with cable



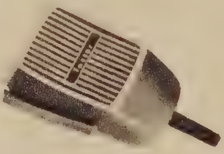
### DF-12/*DF-12B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 80~12,000 c/s±8 dB
†Sensitivity : −57 dB±3 dB,
Dimensions : 23 mm diameter, 158 mm lon
Cable : 3 ϕmm, 1.5 m
Weight : 6.3 oz (180 g) with cable



### *DF-2B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 100~10,000 c/s±10 d
†Sensitivity : −56 dB±3 dB,
Dimensions : 75×53×30 mm
Cable : 3 ϕmm, 1.5 m
Weight : 4.8 oz (136 g) with cable



### *DF-51B

SPECIFICATIONS
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Frequency Response : 150~8,000 c/s±7 dB
†Sensitivity : −57 dB±3 dB,
Dimensions : 98×58×36 mm
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* with switch : † at 1,000 c/s, 0 dB=1 V/μ bar

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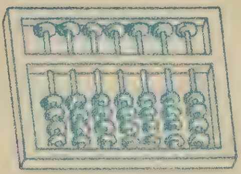
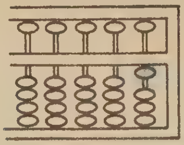
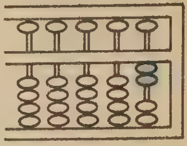
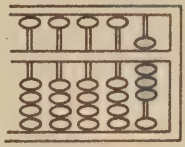




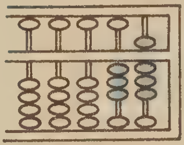
Decimal "1"



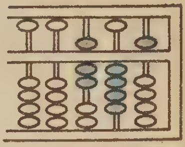
Decimal "2"



Decimal "8"



Decimal "38"



Decimal "745"

*Although a very ancient invention, the "abacus" or bead counter is still widely and effectively used for rapid addition and subtraction. It employs what is known as "qui-binary" coded decimal notation—counting each decade as two groups of five. The diagrams above should help in understanding its operation.*

plication of the reset pulse to the flip- p "R" terminal can be visualised as justing it so that the **first** input pulse ll result in a negative pulse appearing A.

When the first input pulse occurs, en, a negative pulse will be applied a the appropriate coupling capacitor the trochotron "even" grids. As one these is immediately adjacent to the ectron beam currently switched to tar- t $T_0$, this will cause the beam to be pelled from $T_0$; and the tube geometry d fields are so arranged that it is in ct deflected toward spade 1 and target . As soon as some of the electrons e collected by spade 1, its voltage lls, and the beam is thence locked to rget $T_1$ in the same manner as before.

When the second input pulse arrives causes a negative pulse to be produced the flip-flop, not at A but at B—and ence to the trochotron "odd" grids. nd since one of **these** is adjacent to e beam in its new position, the beam ill again be repelled and directed to pade 2 and target $T_2$. Fairly obviously, ch input pulse will cause the beam to ansfer to a new spade and target, hile between pulses it will remain ably associated with the last spade and rget to which it was switched.

And because the switching is being erformed by a beam of electrons mov- g in a vacuum, the counting can occur t quite high speeds—up to about 2MHz, s mentioned before.

Note that there is no provision for irect visual read-out of the count; how- ver, the targets are all brought out to eparate connections to allow use to be ade of the fact that there will be a oltage drop across the load resistor of e target currently associated with the lectron beam. By suitable circuitry onnected to the targets, the voltage rop at this target can be made to pro- uce an indication.

Often a cold-cathode numerical indi- ator tube is used for this purpose; etails of such indication devices will be iven in a later article.

The fact that all 10 targets are rought out separately also makes the ochotron highly suitable for scaling. owever, note that, due to the geometry f the tube and to the fixed magnetic eld, it can switch only in one direc- on. It cannot be used for reverse ounting and is, therefore, at a disad- antage compared with the gas-filled be.

As mentioned earlier, the other main pe of counting circuitry is that which based upon bi-stable circuit elements. owadays this type of circuitry is actu- ally in far more common use than e type which we have just been dis- ussing; accordingly it will be discussed t somewhat greater length.

However, in order that the reader may e helped to a greater understanding an otherwise of the principles involved such circuitry, it will be worthwhile t this point to re-examine our concepts f digital information and numerical otation.

Thus far in the discussion of digital ircuitry given in these articles we have egarded the digital information pro- essed by the circuitry from a logical iewpoint—i.e., as **statements** which may ke either of the two values "true" (1) r "false" (0). And this relatively simple onception of digital information is, in eneral, quite adequate for a considera- on of the basic logical circuit func- ons.

However, it becomes necessary to analyse and expand this concept if one is to understand fully the operation of circuitry used to perform information storage and counting. And also, incidentally, to understand the operation of "arithmetic" circuitry as used in digital computers—although, as mentioned earlier, such circuitry is a little outside the scope of the present articles.

In most cases the content of digital information statements is numerical: i.e., the information is in the form of numerical statements or numbers. And for a digital system having only two possible value-states to easily handle such statements, they should ideally be in the form of dyadic or "two-valued" numerical notation—**binary numbers.**

In order to be reasonably clear in one's conception of digital counting and storage it is, therefore, necessary to become familiar with the general concepts

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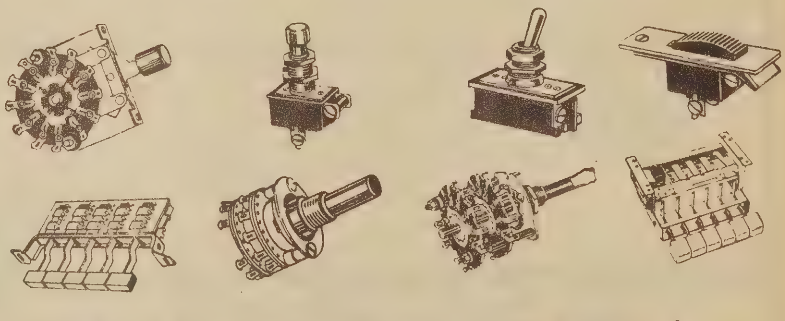

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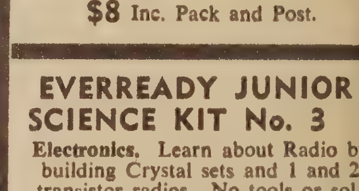

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f numerical notation, with the practi- al, notation systems other than the amiliar decimal system and, in particu- ar with the binary system.

The decimal numerical system to hich most of us are so accustomed, ith its 10 digits, is simply one of an nfinite number of alternative arbitrary ystems for conceiving and symbolising umerical quantities.

It is by no means the only system hich has found practical use: the so- alled "sterling" monetary system now assing out of use employs a combina- on of the **duodecimal** (based on groups f 12) and the **vigesimal** (base 20) sys- ms, while our long-established time- easuring system divides the day into 2 hours (a duodecimal division) and the ours and minutes into 60 parts.

Similarly, in some countries counting as once performed in the **quinary** (base ve) system from which originated the ead-counting "abacus."

Most of these systems use the so-called lecimal digit symbols, i.e., the signs, 0, , 2, 3 . . . , 9. Yet these are just as bitrary as the scaling system adopted. he Romans, as is well known, used a ifferent set of symbols: I, V, X, L, etc.; nd the Arabs, from whom we inherited ost of our present symbols, used a dot symbolise zero instead of our 0.

In general, a practical numeral sys- em adopts a quantity which becomes its ase or "radix"; the base of the decimal ystem is 10, that of the quinary system five, of the binary system two, and so n. Then it gives symbols to the integral uantities encompassed by the base uantity — i.e., "0"—"9", "0"—"4" and 0"—"1" respectively in the decimal, uinary and binary systems.

To cope with quantities larger than e base quantity and also with sub- tegral quantities, the most efficient nd practical course is then to employ e "principle of position"—whereby the bsolute magnitude signified by any of e symbols depends upon its position ith respect to a datum or reference ark. Usually the datum mark is a ot or point—hence the "decimal point," e "binary point" and so on—and the arious positions which the symbols may ccupy either side of this point form a ower series using the same base as the stem.

Thus, in the decimal system we may mbolise a certain quantity as "423.0," vealing by the spoken language equiv- ent, "four hundred and twenty-three," at the quantity signified is:

$$23.0=(4\times 10^2)+(2\times 10^1)+(3\times 10^0)+(0\times 10^{-1}) \quad . . . (1)$$

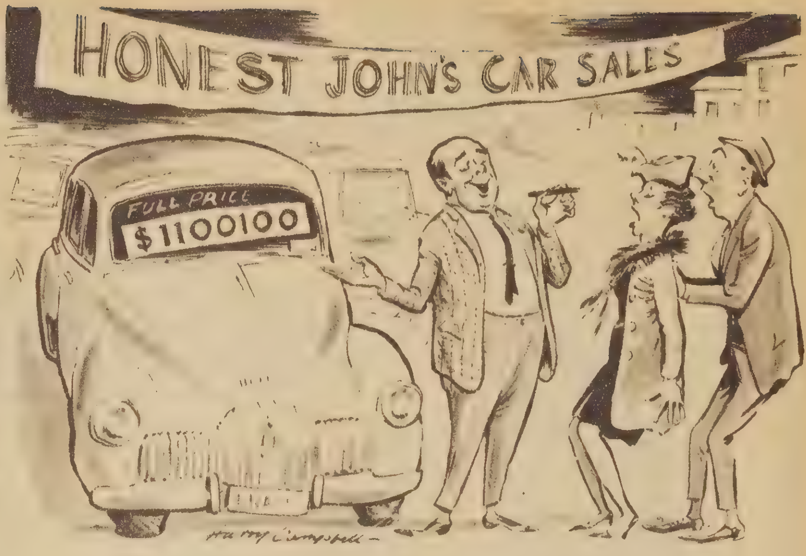
That is, in this system the positions to e left of the "decimal" point increase positive orders or **powers** of the base 0, while those to the right of the point ncrease" in negative powers.

In the quinary system the same set symbols "423.0" means a quite differ- t thing, although the same principles e in operation; the difference is that e positions either side of the "quinary" oint here represent powers of five ther than of 10. Thus:

$$23.0=(4\times 5^2)+(2\times 5^1)\times(3\times 5^0)+(0\times 5^{-1}) \quad . . . (2)$$

Readers may care to check that the uantity thus symbolised in quinary otation is equivalent to "113" in ecimal notation.

Because in the **binary** system there e only two integer symbols required signify the concepts "zero" and "one", in this system the set of signs "423.0" is meaningless. (Or at least half of it must be so: we can, if we wish, make any one of the symbols "4", "2", "3" or "0" signify "one", and signify "zero" by any other, but any way we did this would still leave two meaningless signs). It is usual to employ the familiar signs "0" and "1" to signify the concepts "zero" and "one" in binary notation, as is done in decimal notation.



*". . . of course, that's binary notation."*
*(In numerical notation, it's all a matter of convention . . .)*

To signify the quantity denoted by the decimal symbols "423.0" in binary notation it is simply necessary to adopt a parallel procedure to that in the decimal and quinary systems, in which the positions occupied by the symbols are ordered in a power series: in this case the series will have a base of two. The number will turn out to be "110100111.0"; i.e.,

$$\begin{aligned}110100111.0=&(1\times 2^8)+(1\times 2^7)+(0\times 2^6)\\&+(1\times 2^5)+(0\times 2^4)+\\&(0\times 2^3)+(1\times 2^2)+(1\times 2^1)\\&+(1\times 2^0)+(0\times 2^{-1})\\=&\text{decimal } 423.0 \quad . . . (3)\end{aligned}$$

It may be seen that although binary notation requires greater numbers of its symbols than does any other system (compare "423" with "110100111"), each position which the symbols may occupy has only two possible values. It is this characteristic which makes binary notation ideally suited to the representation of numbers processed by electronic circuits, as mentioned earlier, because circuitry designed to have only two possible value-states has maximum reliability and predictability of operation.

And while binary notation is less economic than others with regard to the number of symbols required to represent a given number, its economy of symbol variety leads to a quite radical simplification of arithmetic. For example, the laws of addition reduce to

$$\begin{aligned}&0+0=0\\&0+1=1+0=1\\&1+1=0 \text{ and carry } 1 \quad . . . (4)\end{aligned}$$

Astute readers may note a resemblance between these laws and those of Boolean algebra of logic given in the first article of this series: a small demonstration of the Russell-Whitehead postulate that logic is the foundation of mathematics.

However, to continue: Although it is often most convenient to use binary notation to represent numbers within a digital system, this does not mean that the numbers need necessarily be fed into or out of the system in this notation. Although the latter can be done if required, it is usually quite easy to arrange decimal-binary and binary-

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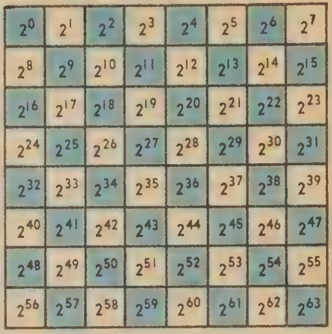


| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $2^{0}$ | $2^{1}$ | $2^{2}$ | $2^{3}$ | $2^{4}$ | $2^{5}$ | $2^{6}$ | $2^{7}$ |
| $2^{8}$ | $2^{9}$ | $2^{10}$ | $2^{11}$ | $2^{12}$ | $2^{13}$ | $2^{14}$ | $2^{15}$ |
| $2^{16}$ | $2^{17}$ | $2^{18}$ | $2^{19}$ | $2^{20}$ | $2^{21}$ | $2^{22}$ | $2^{23}$ |
| $2^{24}$ | $2^{25}$ | $2^{26}$ | $2^{27}$ | $2^{28}$ | $2^{29}$ | $2^{30}$ | $2^{31}$ |
| $2^{32}$ | $2^{33}$ | $2^{34}$ | $2^{35}$ | $2^{36}$ | $2^{37}$ | $2^{38}$ | $2^{39}$ |
| $2^{40}$ | $2^{41}$ | $2^{42}$ | $2^{43}$ | $2^{44}$ | $2^{45}$ | $2^{46}$ | $2^{47}$ |
| $2^{48}$ | $2^{49}$ | $2^{50}$ | $2^{51}$ | $2^{52}$ | $2^{53}$ | $2^{54}$ | $2^{55}$ |
| $2^{56}$ | $2^{57}$ | $2^{58}$ | $2^{59}$ | $2^{60}$ | $2^{61}$ | $2^{62}$ | $2^{63}$ |

ecimal conversion circuitry so that the put and output to the system can be familiar decimal form. This, despite e fact that the information is handled most exclusively in binary form by e system in performing the required gical, counting or arithmetic operations.

It will be to our purpose to examine e binary "codes" used to represent ecimal numbers in digital circuitry, as ich codes are often involved in readut of bi-stable counting circuits.

The binary notation which has been nsidered to this point is what is often rmed "pure binary" notation — in hich, as we have seen, the positions hich the binary digits 0 and 1 may ccupy represent magnitudes forming a ower series to the base 2. Yet this is y no means the only way of ordering binary scale using the same two digits; r some purposes it proves more conenient to employ a binary notation hich uses a different ordering.

An example of a situation where it is ften preferable to use other than pure nary notation is where the input and tput to a system must be in decimal rm, necessitating the decimal-binary d binary-decimal conversion proceures to which mention has been made. certain cases such conversion is easier the binary notation used is other an "pure binary."

Irrespective of the binary notation nployed, a minimum of four binary gits or **"bits"** are required to represent e 10 decimal digits; three binary bits e not sufficient, as these would provide nly seven different bit combinations. As e following table of "pure binary" quivalents to decimals 0-15 illustrates, ur binary bits provide 16 available ifferent bit combinations.

| Decimal | Binary |
|---|---|
| 0 | 0000 |
| 1 | 0001 |
| 2 | 0010 |
| 3 | 0011 |
| 4 | 0100 |
| 5 | 0101 |
| 6 | 0110 |
| 7 | 0111 |
| 8 | 1000 |
| 9 | 1001 |
| 10 | 1010 |
| 11 | 1011 |
| 12 | 1100 |
| 13 | 1101 |
| 14 | 1110 |
| 15 | 1111 |

To represent the decimal numbers 0-9, nly 10 of these 16 combinations are quired; and from a general theoretical ewpoint **any** group of 10 of the cominations is equally capable of reprenting the decimal numbers. Thus eoretically there are quite a large umber of available different binary-ded-decimal or "BCD" codes—some $.6\times10^7$, in fact. Not all of these are sed (!), but it will be worthwhile to ok briefly here at a few of those more mmonly used.

The "pure binary" equivalents to the ecimal digits—i.e., those above the ashed line in the above table — are nown as "8421 BCD." They are given is name to signify that the four binary it positions are "worth" or have the eight of decimal digits 8, 4, 2 and 1 spectively. The main use for this code for binary arithmetic.

A code which is often used in digital easuring instruments because of the lative ease in designing counting circuits which use it is "2421 BCD," where the weight of the binary bit positions are 2, 4, 2 and 1 respectively. It is identical with 8421 BCD for decimal digits 0-7, but uses the pure binary numbers 1110 (decimal 14) and 1111 (decimal 15) to represent decimals 8 and 9.

Where numbers must be stored in devices which must consume appreciable power it is convenient to employ a code using the minimum number of "ones" (as "1" is usually associated with a conductive state) to conserve power. A code which is useful from this point of view is "7421 BCD," in which no representation of a decimal number uses more than two 1's.

Again, in some types of arithmetical operation it is desirable that the code used exhibits a characteristic known as "9's complementation by bit complementation." By this is meant that the complement of a decimal number X with regard to decimal 9 (i.e., the number 9−X) is formed simply by replacing all four of the binary bits representing X with their individual complements.

For example in a code which exhibits this characteristic the bits representing decimal 3 will be the complements of those which represent (9−3) = 6, and so on. A code which has 9's complementation by bit complementation is the "4311 BCD" code shown in the following table for comparison with 8421 BCD, 2421 BCD and a 7421 BCD:

| Decim. | 8421 BCD | 2421 BCD | 7421 BCD | 4311 BCD |
|---|---|---|---|---|
| 0 | 0000 | 0000 | 0000 | 0000 |
| 1 | 0001 | 0001 | 0001 | 0001 |
| 2 | 0010 | 0010 | 0010 | 0011 |
| 3 | 0 11 | 0011 | 0011 | 0100 |
| 4 | 0100 | 0100 | 0100 | 1000 |
| 5 | 0101 | 0101 | 0101 | 0111 |
| 6 | 0110 | 0110 | 0110 | 1011 |
| 7 | 0111 | 0111 | 1000 | 1100 |
| 8 | 1000 | 1110 | 1001 | 1110 |
| 9 | 1001 | 1111 | 1010 | 1111 |

It should be noted that there are in fact more than one of some of the above codes. This arises because some of the weighting systems allow alternative representation for certain of the decimal numbers; for example in 4311 BCD, decimal "5" could be represented equally validly by "0111", "1001" or "1010". **There are in fact 18 different 4311 BCD codes.**

Note also that in any BCD code the representation of decimal numbers larger than 10 is carried out by using four-bit groups to represent each decimal digit in the number. But while the resulting binary number will look the same as a pure binary number, it will in fact have a completely different meaning. Whereas in pure binary

$$11100100=(1\times2^7)+(1\times2^6)+(1\times2^5)+(1\times2^2)=\text{decimal } 228 \quad \ldots(4)$$

the same digits in 2421 BCD would have the meaning

$$11100100=(1110)+(0100)=\text{decimal } 84 \quad \ldots(5)$$

All the binary codes considered so far have been what are known as "fixed weighting" codes, because each of the four bits used consistently carries a certain weight, as designated by the code name. It is by no means necessary for a code to have fixed weighting, however.

An example of a variable-weighting code is the so-called "reflected binary" code, in which the representations of successive decimal digits differ by only one bit. Reflected binary code finds considerable use in applications where analog quantities such as continuously varying voltages, pressures, temperatures, shaft positions, etc., must be encoded digitally or "digitised."

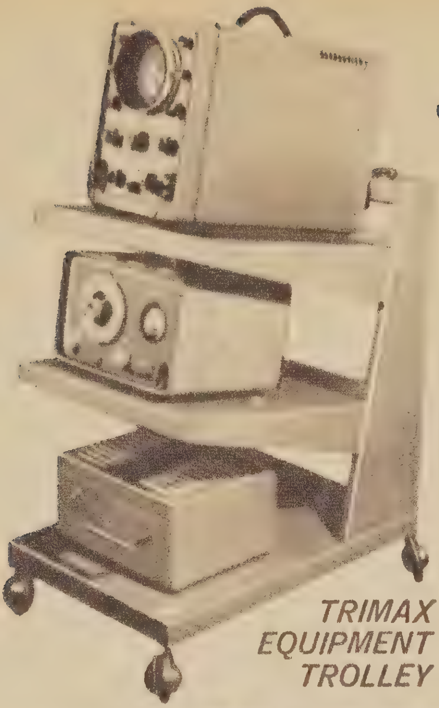
When changing from one reading to another in such applications, reflected binary code is less liable to error than other codes because it does not depend upon a number of bits changing value in exact synchronism. Codes in which more than one bit has to change in value in changing a reading tend to produce spurious readings during the transition, as it is generally not possible to guarantee that all bits change value at exactly the same time.

Reflected binary code is shown below compared with pure binary. The reader may care to check for himself that none of the bits has fixed weights and that only one bit changes value between successive decimal digits. Note in contrast that in pure binary all four bits change value when progressing from decimal 7 to decimal 8.

| Decimal | Binary | Reflected BCD |
|---|---|---|
| 0 | 0000 | 0000 |
| 1 | 0001 | 0001 |
| 2 | 0010 | 0011 |
| 3 | 0011 | 0010 |
| 4 | 0100 | 0110 |
| 5 | 0101 | 0111 |
| 6 | 0110 | 0101 |
| 7 | 0111 | 0100 |
| 8 | 1000 | 1100 |
| 9 | 1001 | 1101 |

The reflected binary code is sometimes called the "Gray" code, in honour of its inventor Elisha Gray.

In concluding this necessarily rather brief discussion of numerical codes, mention should perhaps be made of methods



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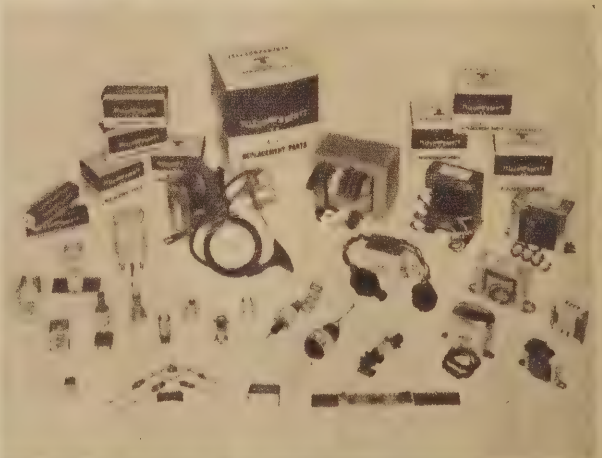

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48

sed to detect errors which inevitably ccur in coding due to switching inccuracies, transmission noise, brief ailures in the system, and so on.

In general, error detection and correcion makes use of what is called infornation **redundancy**, where the redunancy of a piece of information or "mesage" is defined as the ratio of the unsed information potential of its symbols o the capacity actually being utilised. hus if a notation system employs a set f symbols giving "M" possible differnt symbol combinations, but only uses N" of these symbol combinations to epresent meaningful messages, it has a edundancy "r" given by the equation.

$$r = \frac{M-N}{M} \qquad \ldots (6)$$

From this it may be seen that redunlancy is virtually the opposite of symolic economy. If we use all the posible combinations of a set of symbols, ve obtain a code with maximum econmy of symbols—using the least numer of symbols to carry a certain mesage—but the code will conversely have ero redundancy. As every combination f the symbols will have a meanng, any error which changes the symols of a message will produce a new nessage which is equally feasible as far s the receiver of the message is conerned. There will be no possibility hat such an error may be detected by ts production of a "silly" or meaningess combination.

An example of a code with zero reundancy is pure binary notation (but ot 8421 BCD).

Increasing the redundancy of a code educes the symbolic economy by making t necessary to use more than the absoute minimum number of symbols to arry a certain message. However, the igher the redundancy the higher the robability that errors may be detected ecause of the production of meaningless ymbol combinations. And if the redunancy is increased above about 0.5, it ften proves possible for errors to be ot only detected but corrected as well.

An example of the latter is our own nglish language. This has a very high verage redundancy, because while the umber of "sensible" combinations of its 6 letters is large, it is still a small fracion of the total number of possible cominations. Thus, it is not particularly ard to decipher the following distorted nessage, despite its nine character rrors in a total of 48:

**"Im wintar thc lakis anf rivers ohtem reez ober."**

The BCD codes discussed in this rticle all have a small but useful reundancy, because they use four binary its to represent the ten decimal digits vhen, as we saw earlier, four bits are apable of representing a total of 16 umbers. In theory, a total of only .32 bits would be required to represent he decimal digits, so that using the equation given above, the four-bit BCD codes have a redundancy of:

$$r = \frac{4-3.32}{4} = 0.17 \qquad \ldots (7)$$

In other words, whichever 10 of the 16 possible four-bit combinations are used in a BCD code, there remain six "forbidden" or meaningless combinations whose appearance indicates that an error has occurred. But fairly obviously there are many possible errors which could occur **without** producing one of these combinations; thus a redundancy of 0.17 as possessed by the four BCD codes, while useful, is by no means sufficient to detect all possible errors.

There are a number of techniques by which the redundancy is increased to allow error detection and correction. Some codes use an additional binary bit called the "parity" bit, and adopt a convention that the parity bit always takes a value to make the total number of "1's" in every group an even number (or always an odd number). This system will show up any errors which produce a single change in the total number of 1's in each group.

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Another technique is to add additional bits whose value is arranged so that each group has a certain fixed number of 1's and 0s. Thus, there is the "2-out-of-5" code in which two, and only two, of the five bits in each group are 1's, and the "2-out-of-7" or **biquinary** code in which two and only two of each group of seven bits are 1's. A more detailed discussion of these and similar techniques is beyond the scope of these articles, but the forgoing should provide useful insight into the principles involved.

Although from space considerations it is necessary to close the present article at this point, the forgoing discussion of numerical notation and binary coding should have laid useful groundwork for much of the material to be presented in the next article in this series. The latter article will deal with the flip-flop and its application to counting, and will give details of a second panel for the digital "demonstrator" unit.

**(To be continued)**

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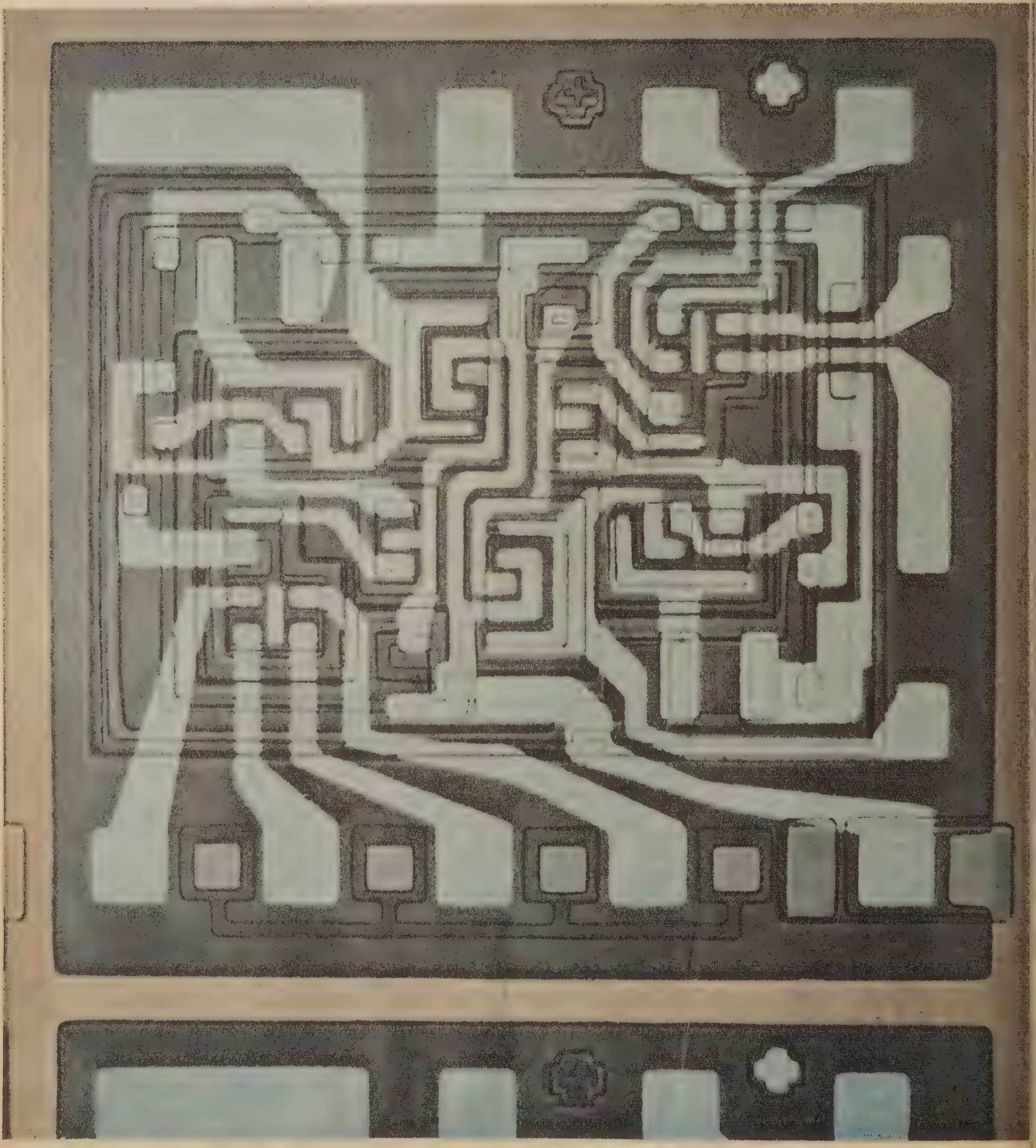

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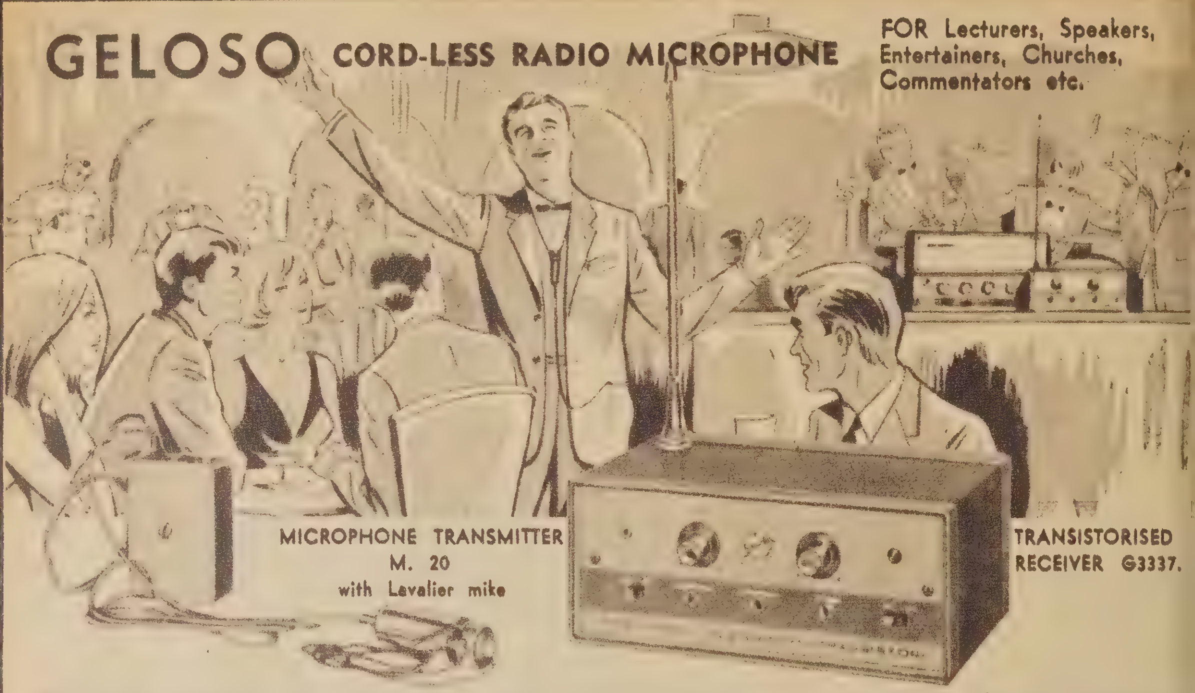
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***Price includes dynamic Mic, Tape and Spool***

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Definitely superior in every respect to any other recorder under £100. Model TR9 special fitted with 3rd head —sound-on-sound—Dual track operation—high level stereo—sound with sound—Monitor tape or signal—Echo—Mixing £18 extra. Recording tapes at reduced prices, 7in 1200ft. /£1/10/.

**ASK FOR PAMPHLETS**

# An All-Transistor VFO

This silicon transistor VFO should be of special interest to all operators of amateur radio stations. Styled as a single-coverage remote tuning head, it can nevertheless be readily set up for use with HF or VHF transmitters or transceivers. It minimises drift problems without recourse to temperature compensating circuitry by the simple expedient of avoiding heat rise within the unit.

**By Keith Woodward**

Few radio amateurs will argue the value of VFO control on the HF bands and a majority of the 52 MHz transmitting tations are now VFO controlled. Further, with transceivers appearing on 144MHz, the ability to net on the calling station allows quick contact to be established. During VHF contests t is quite often desirable to be able to shift off a crowded requency or, again, to call close in frequency to a station igning off with another contestant.

There is thus a good case for providing for VFO operation, not only on the HF bands but also at 52 and 144MHz. The VFO, as described here, can be set up directly o cover the ranges 3.5 to 3.7MHz, 4.333 to 4.5MHz or 4.0 o 4.06MHz. This will allow coverage of the HF bands on he first setting, a span of 52 to 54MHz on the second setting and 144-146MHz on the third setting, assuming the appropriate order of multiplication.

Since the range setting is so readily adjustable, other frequencies may be selected for heterodyne exciters.

The LC constants could be changed to give reliable service up to at least 10MHz, the upper limit at which this circuit was tested. This would allow the VFO to be used in conjunction with some SSB transceivers, making the original oscillator valve a buffer or multiplier. Some earlier model ransceivers did exhibit a drift rate much higher than this unit and, depending on the complexity of the alteration, could be teamed with this VFO for more stable operation.

The prototype was checked for stability on the fundamental ranges against crystal controlled standards, which showed the drift at the fundamental to be extremely low.

Following these tests we fed the unit into a 144MHz ransmitter and conducted stability tests on this frequency, which is 36 times the fundamental. We cannot quote exact igures for the checks on 144MHz, as we cannot be too dogmatic about the stability of the comparator equipment available at the checking site. However, the amount of drift appeared to be quite small and readily acceptable in terms of present-day amateur practice.

As a further check on the performance at these frequencies, a number of VHF stations around Sydney were contacted on 144MHz using the VFO and reports sought on the stability of the signal under actual working conditions. A variety of receiving equipment was encountered at these stations but all were unanimous that the signal was quite stable and acceptable in quality. One station reported that a check with his BFO during a normal transmission indicated no discernible drift during the length of the transmission, approximately three minutes.

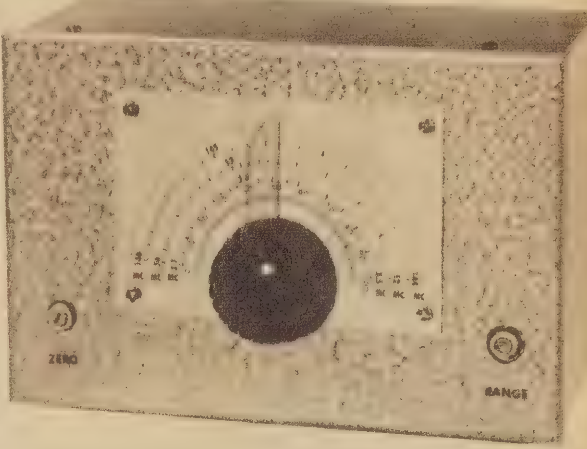
On the strength of these tests, the writer has no hesitation in recommending the use of this VFO for all modes including SSB on the HF bands and for AM transmitters on the VHF bands. It also could be used in heterodyne exciters for all modes in the VHF bands.

The number of components used in the VFO is quite small and the transistors used are readily available at a very reasonable price. We used a two-speed vernier dial on the prototype which proved to be quite adequate for HF. However, at 144MHz it does become a little difficult to net exactly on a given frequency. This is one of the reasons why we nominated the coverage of 144 to 146MHz only, as it does give a little extra bandspread. If you are interested in a smaller coverage, say 144 to 145MHz, the additional bandspread will make tuning to spot frequencies that much easier.

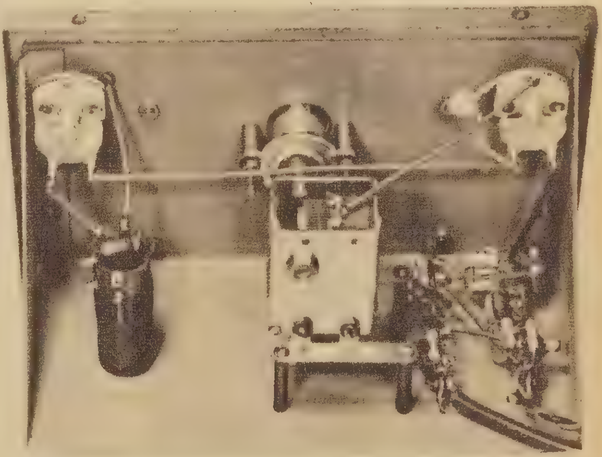
The only components which may be a little difficult to obtain are the two pre-set lockable type capacitors. However we understand that supplies will be available from Watkin Wynne Pty. Ltd. who also supplied the tuning capacitor and two-speed dial.

With the standard tuning capacitor used in the prototype we obtain a non-linear scale which gives more bandspread at the lower end of the frequency range. This is, in fact, desirable when operating on high multiples of the fundamental frequency, remembering that operators tend to favour the lower frequency end of the VHF bands.

(Parallel work by fellow staff member Ian Pogson indicates that this general configuration can be adapted readily enough to give a substantially linear frequency scale. The series and parallel capacitors have to be increased in value and the coil inductance reduced to retain the requisite coverage. However, the implications of decreased L/C ratio have not been fully investigated, in terms of stability, limit of operating frequency or RF output voltage.)



*The completed all-transistor VFO. The pre-set "zero" adjustment is at the lower left of the panel, the preset "range" adjustment at the lower right.*



*An inside view of the prototype VFO. In the interests of good panel layout, the "works" mount upside-down in the case, with capacitor and coil hanging from the chassis bracket and the pre-set capacitors at the bottom.*

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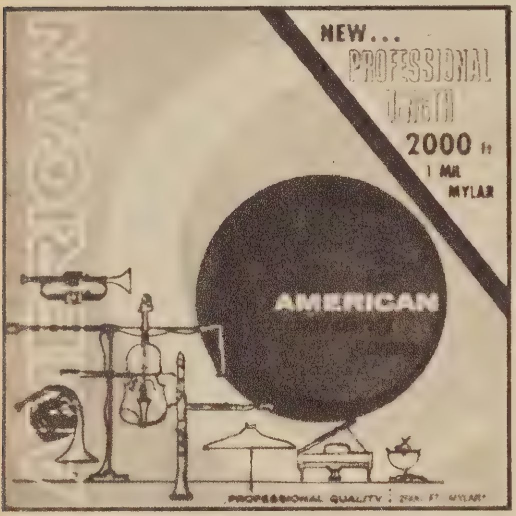

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|---|---|---|---|---|
| 1A | A | 150′ | 3″ | $0.85 |
| L2A | A | 225′ | 3″ | $1.05 |
| L2M | M | 225′ | 3″ | $1.18 |
| D3MT | MT | 300′ | 3″ | $1.65 |
| 3A | A | 300′ | 4″ | $1.50 |
| L4A | A | 450′ | 4″ | $1.92 |
| D6MT | MT | 600′ | 4″ | $3.30 |
| 6A | A | 600′ | 5″ | $2.30 |
| 6M | M | 600′ | 5″ | $2.80 |
| L9A | A | 900′ | 5″ | $3.00 |
| L9M | M | 900′ | 5″ | $3.62 |
| D12MT | MT | 1200′ | 5″ | $5.75 |
| 9A | A | 900′ | 5¾″ | $3.05 |
| L12A | A | 1200′ | 5¾″ | $4.48 |
| L12M | M | 1200′ | 5¾″ | $5.10 |
| D18MT | MT | 1800′ | 5¾″ | $7.90 |
| 12A | A | 1200′ | 7″ | $3.75 |
| 12M | M | 1200′ | 7″ | $4.48 |
| L18M | M | 1800′ | 7″ | $6.15 |
| L18A | A | 1800′ | 7″ | $5.10 |
| D24MT | MT | 2400′ | 7″ | $9.70 |

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| D5MT | MT | 500′ | 3″ | $2.1 |
| 2A | A | 250′ | 3¼″ | $1.0 |
| L3A | A | 350′ | 3¼″ | $1.3 |
| L3M | M | 350′ | 3¼″ | $1.5 |
| D6MT | MT | 600′ | 3¼″ | $2.4 |
| D18MT5 | MT | 1800′ | 5″ | $7.0 |
| 15A | A | 1500′ | 7″ | $4.4 |
| L20A | A | 2000′ | 7″ | $5.7 |
| L20M | M | 2000′ | 7″ | $7.0 |
| DD24MT | MT | 2400′ | 7″ | $12.6 |
| D30MT | MT | 3000′ | 7″ | $11.7 |
| D36MT | MT | 3600′ | 7″ | $13.7 |

### SPECIAL TYPES

| | | | | |
|---|---|---|---|---|
| HO6A | A | 600′ | 5″ | $3.4 |
| HO6M | M | 600′ | 5″ | $3.9 |
| HO12A | A | 1200′ | 7″ | $5.0 |
| HO12M | M | 1200′ | 7″ | $6.0 |
| LP12A | A | 1200′ | 7″ | $6.2 |
| LP12M | M | 1200′ | 7″ | $10.7 |

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The coil used in our model was wound n a Telecomponents former, as per etails on the circuit diagram. Any coil ormer of similar diameter should be uitable, a bakelised cardboard type be- ıg preferred for ease of working and easonable temperature coefficient. The ain requirement is for good mechanical ability.

In our search for a suitable circuit r the VFO we tried several configura- ons. While many of these exhibited ood stability without load, they were usceptible to loading reflected from ollowing circuits. The circuit finally elected was derived from one featured September 1963 "CQ" by Comman- er P. H. Lee. The original circuit fea- red 2N384 transistors for which either

## PARTS LIST

- *1 Instrument case, with biscuit-tin lid, 7½ x 5 x 4 inches.*
- *1 Roblan tuning capacitor, 415pF.*
- *1 Two-speed Jabel dial.*
- *1 Pre-set Polar capacitor, 26.4pF.*
- *1 Pre-set Polar capacitor, 50pF.*
- *1 Coil former ¾in diameter.*
- *2 Tagstrips, 10 lugs, earth lugs at both ends.*
- *1 Short length of coaxial cable.*
- *2 BF115 silicon transistors.*

*RESISTORS (all ½-watt)*

- *1 1K 5%*
- *1 2.2K 5%*
- *1 4.7K 5%*
- *2 15K 5%*
- *1 22K 5%*

*CAPACITORS*

- *1 82pF styroseal*
- *1 120pF 5% styroseal*
- *1 470pF styroseal*
- *1 .001uF 5% styroseal*
- *1 .003uF 5% styroseal*
- *1 .22uF 160VW plastic*

*Other capacitors used in tuned circuit are 5% styroseal or NPO ceramic. See circuit diagram for details.*

*MISCELLANEOUS*

*A section of 16g aluminium for chassis, tinned copper wire, enamelled copper wire, 4 tubular pillars, screws, nuts, spaghetti, solder, etc.*

C171 or AF114N transistors could be ubstituted.

We did, in fact, try these germanium ansistors and found the circuit rela- vely stable. However, the small drift hich was noticeable was traced, in part, the use of germanium transistors. A light rearrangement of the circuit, to- ether with the use of silicon transistors, roduced the final version of the VFO, s here presented.

The BF115 silicon transistors chosen ere cheaper than the OC171 and the ame price as the AF114N, so we lost othing in price by using silicon tran- stors and gained an improvement in erformance. Price-wise, the two tran- stors are only slightly dearer than a ommon twin-triode valve.

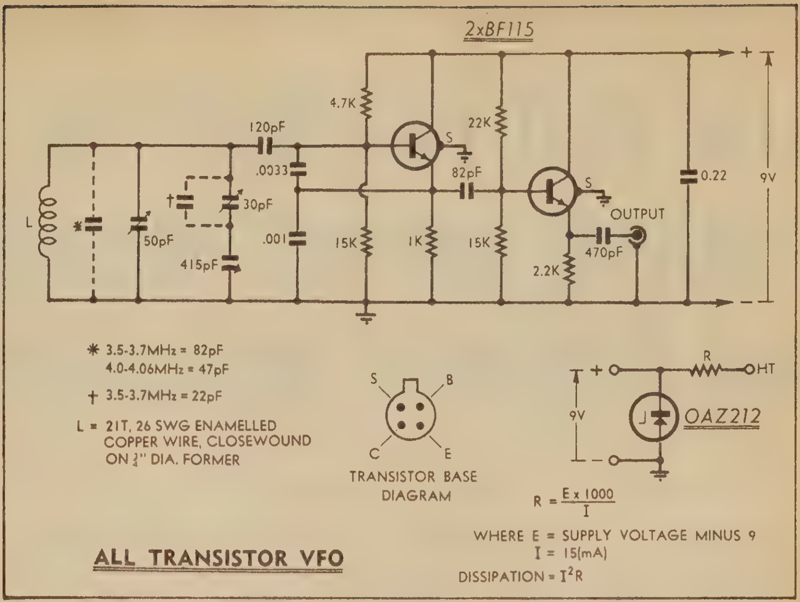
The secret of the stability of this oscil- ator is largely in the loose coupling be- veen the oscillator transistor and the ined circuit. This is ensured by voltage- ivider action of three capacitors in eries across the tuned circuit, which stablish low impedance points for con- ection to the transistor emitter and ase.

The oscillator emitter couples also into the base of an emitter-follower, the second BF115 transistor. The emitter-follower configuration does not give any voltage amplification but does provide a degree of isolation between the input and output circuitry. Unfortunately, the isolation is not quite as good as may be obtained by equivalent valve circuitry but it is, nevertheless, of a very useful order.

The RF output voltage into an open circuit will fall between 0.5 and 1.0 volt, assuming a 9-volt DC supply. This is inadequate for most applications and will require further amplification. A subsidiary circuit is given of a typical valve amplifier which produces approximately 15 volts of RF from the drive available from the VFO.

Although we have suggested a 6EH7 valve for this application, there is no reason why other high-gain RF valves should not be used. With the correct operating voltages such valves as the 6AM6, EF50, 6AC7, etc., would serve the purpose. This stage is intended to operate as a class-A amplifier and the bias should be set accordingly. Listen to the fundamental beating against an accurate crystal standard to ensure that there is no discernible frequency shift when the plate circuit of the amplifier is tuned through resonance.

Such a class-A amplifier would normally be situated on the transmitter chassis and it may be possible to utilise the existing crystal oscillator valve for the purpose, depending on the drive requirements. There should be little difficulty in the case of an SSB transceiver where drive requirements into a mixer from the existing oscillator are normally quite modest.



*The circuit of the new VFO is relatively simple and free from critical components. With heat rise largely eliminated within the assembly, stability will be governed mainly by mechanical rigidity and the re-set qualities of the variable capacitor and dial system.*

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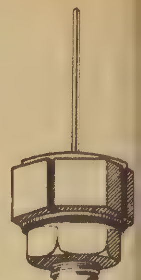

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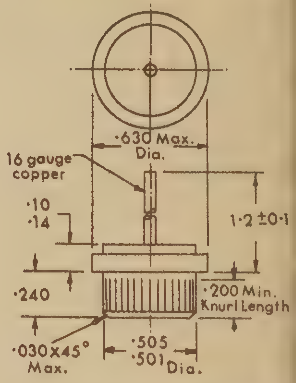

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|---|---|---|---|---|---|---|---|
| Peak inverse voltage | **50** | **100** | **200** | **50** | **100** | **200** | **Volts** |
| Sine wave R.M.S. supply voltage (Resistive load only) | **35** | **70** | **140** | **35** | **70** | **140** | **Volts** |
| Sine wave R.M.S. supply voltage (Capacitive or battery load.) | **17** | **35** | **70** | **17.5** | **35** | **70** | **Volts** |
| Average half wave rectified forward current. @ 100°C case<br>@ 150°C case | **30**<br>**25** | **30**<br>**25** | **30**<br>**25** | **25**<br>**18** | **25**<br>**18** | **25**<br>**18** | **Amps** |
| Recurrent peak forward current (50 cps and 25°C case) | **100** | **100** | **100** | **75** | **75** | **75** | **Amps** |
| Peak one cycle surge current (50 cps and 150°C case temp.) | **400** | **400** | **400** | **300** | **300** | **300** | **Amps** |
| Forword voltage drop @ 25 Amp. D.C., Forword current | **1.2** | **1.2** | **1.2** | **1.2** | **1.2** | **1.2** | **Volts** |
| Average full cycle reverse current at rated P.I.V. and I.F. (Resistive load, 150°C case.) | **5.0** | **4.5** | **4.0** | **10** | **10** | **8** | **mA** |
| Thermal resistance junction to case | **1.0° C/WATT TYPICAL** | | | | | | |
| Operating junction temperature. | **+175° C** | | | | | | |

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A11

We found it unnecessary to used a tuned circuit at the input of the class-A amplifier stage, but it is wise to avoid an unduly long coaxial lead between the VFO and the transmitter. Our lead was approximately 26in in length.

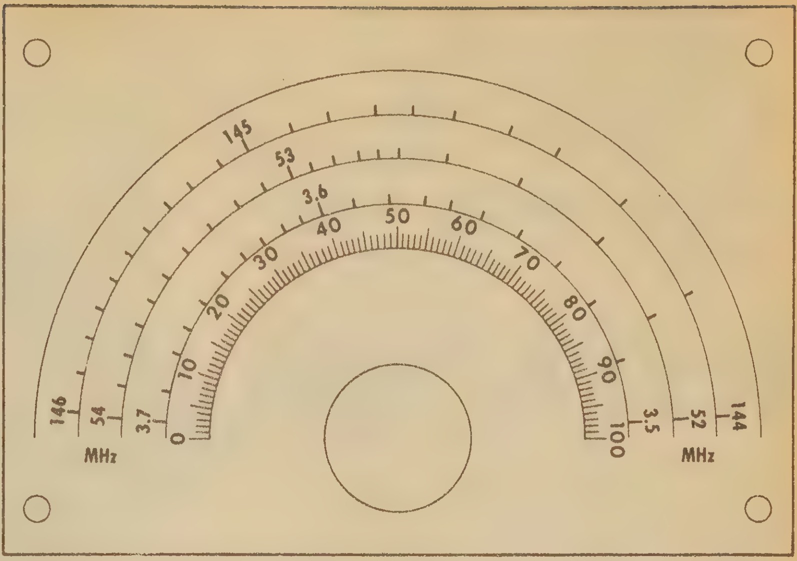
Note that our circuit has been featured with the negative rail at chassis potential. This was done with two thoughts in mind: The first was that a suitable dropping resistor and zener diode arrangement could be used from the transmitter high tension line. Secondly, the VFO could be powered from the battery in a vehicle, the greater proportion of which use negative earth systems. While the VFO works quite well on 12 volts we would not recommend this for use above 30MHz.

During all our tests we used a regulated power supply and we recommend that some type of regulation be used with all supplies to obtain maximum stability. This could, in most cases, be a zener diode/dropping resistor combination. Zener regulation could prove beneficial in mobile applications when the vehicle is in motion, since the battery voltage will vary with generator speed.

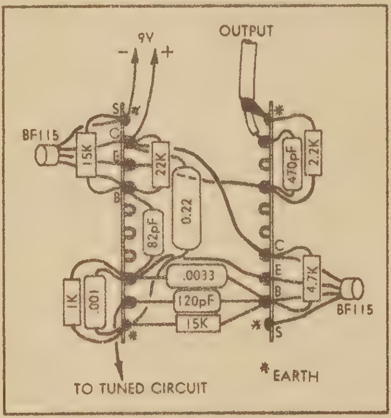
While the VFO is relatiyely free from temperature drift, the circuit is sensitive to variations in supply voltage, hence the warning regarding regulation. Details for designing the zener regulated supply to suit the existing power supply are given on the main circuit diagram.

A final and vital consideration with this VFO, as with all VFOs, is the mechanical construction. The VFO will be only as good as the workmanship put into the unit. We went to the trouble of bending up a substantial chassis with side wings to give rigid support to the components used in the tuned circuit. Because of these side-wings it was necessary to use a small spacing washer under one leg each of the range and zero variable capacitors.

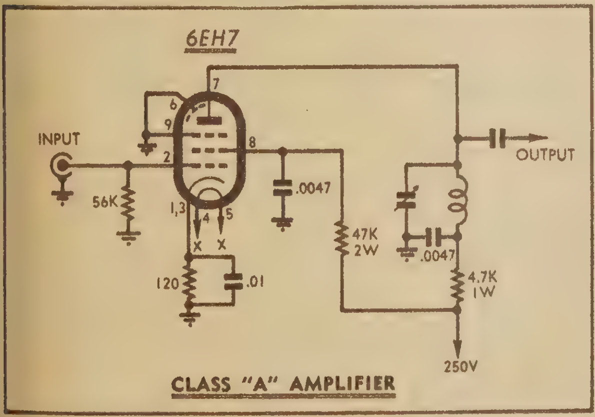
The wiring between the components in the tuned circuit consists of spaghetti-covered tinned-copper wire. Remember, the time taken to make the unit mechanically stable and the dial alignment exact will pay for itself in performance.



*Reproduced approximately full size, this is the dial scale of the prototype unit. Normally the VFO would be set up to one range only. Where multiple transmitters are used, it is probably easier to provide additional VFOs than to arrange changeover and bandswitching.*



*The diagram above shows the arrangement of small components on the tagstrips.*



*Since the RF output voltage of the VFO is relatively small, it would normally be followed by a buffer amplifier as at left.*

The tuning capacitor is mounted on pillars approximately 1-1/16 inches long. These pillars may be adjusted in length to achieve exact alignment of the tuning capacitor and dial drive. This is important with vernier drives as they will slip if any binding occurs.

For purposes of illustration, the VFO dial is shown calibrated for three bands but it will normally be used for only one of these bands at any time. To set up the VFO we have provided in the design two pre-set capacitors. As one of these capacitors is above chassis potential, it is necessary to make sure that the adjustment shaft does not foul the clearance hole in the front panel.

This pre-set capacitor in series with the tuning capacitor sets the amount of coverage available. The second pre-set capacitor sets the lowest frequency of the operating range. For instance, to set up the VFO to cover 3.5 to 3.7MHz set the range capacitor to approximately mid-scale, the tuning capacitor to full capacitance and vary the zero capacitor to achieve a frequency of 3.5MHz.

Now swing the tuning capacitor to minimum capacitance and check the frequency. Should this only reach say 3.6 MHz, the range control should be increased in capacitance. However, if the range is too big, say to 3.9MHz, the range capacitance value should be decreased. Either way, it will be necessary to re-set the zero capacitor to give the correct frequency of 3.5MHz with the tuning capacitor fully in mesh. After a few tries the correct operating range should be obtained.

The same procedure may be used for the other ranges specified. When setting up on the VHF bands, be careful to see that an incorrect harmonic is not selected. Probably the best method to employ for the VHF bands is to set up the VFO on its fundamental against a frequency meter or, at the worst, a general coverage receiver and then do the final check on the VHF band.

A blueprint of the metalwork will be available from our information service for 50c as well as a reproduction of the original dial scale for 20c. This scale will only hold true if a similar gang to the original is used.

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| | 43-9 | 900 | 5 | 4.00 | 2.00 |
| | 43-18 | 1800 | 7 | 6.50 | 3.25 |
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| | 52-9 | 900 | 5 | 4.40 | 2.20 |
| | 52-18 | 1800 | 7 | 7.50 | 3.75 |
| ***Ferrotape 53** • ½ mil Polyester Base • Extra Long Play Type 53 is for extended play applications where care is exercised in handling. It should be used only on equipment in good adjustment and by an experienced recordist.* | Extra Long Play ½ mil Polyester | | | | |
| | 53-12 | 1200 | 5 | 4.60 | 2.30 |
| | 53-24 | 2400 | 7 | 8.50 | 4.25 |
| ***Ferrotape 56** • ½ mil Tensilized Polyester Base • Extra long play • Extra Strength.*<br>*Type 56 ½ mil Tensilized Polyester makes it extremely strong and stretch-resistant, retaining the extended play features.* | Extra Long Play ½ mil Tensilized Polyester | | | | |
| | 56-12 | 1200 | 5 | 6.50 | 3.25 |
| | 56-24 | 2400 | 7 | 11.00 | 5.50 |
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# The ABC-Five

*—Being a logical follow on from our recently described "ABC Three" and "ABC Four". It is a full size receiver which, suitably housed, can take its place in any lounge room. It can also provide the basis for a simple radiogram.*

**By Philip Watson**

As with the "ABC Three" (February, 966) and the "ABC Four" (March, 966), this new project is aimed at those :aders who find themselves in posses- on of one or more old receiver chassis 'om which a large number of perfectly ɔod major components may be salvaged.

However, unlike the previous projects, ıe end result is not simply a novel re- :iver which only the builder himself is kely to enjoy. This design is for a ıll-size five-valve receiver of the kind 'hich supplied the domestic market for ıany years in the past. It is capable of rst-rate radio performance, and a pair f pickup terminals enable it to form the asis for a simple mono record-player.

This design was first presented as the Basic Five" of December, 1955, and roved a popular project, even in those ays. For this presentation we have re- ıined the original circuit, wiring dia- rams, photographs, etc., since these are ıst as valid as they were eleven years go. However, we have revised the text ) bring it up to date where necessary, nd also the list of alternative valve 'pes, which now include the miniature :ries. If chassis using these types are ot already finding their way to the junk eap, they almost certainly will be in ıe not too distant future.

Coming to the set proper, there are a umber of points to be considered. For project of this kind, the five-valve con- guration is particularly suitable, since it ormally provides a considerable reserve f sensitivity. This means that we have ɔme margin which can be sacrificed, necessary, in the interests of adapting to a wide range of valve types.

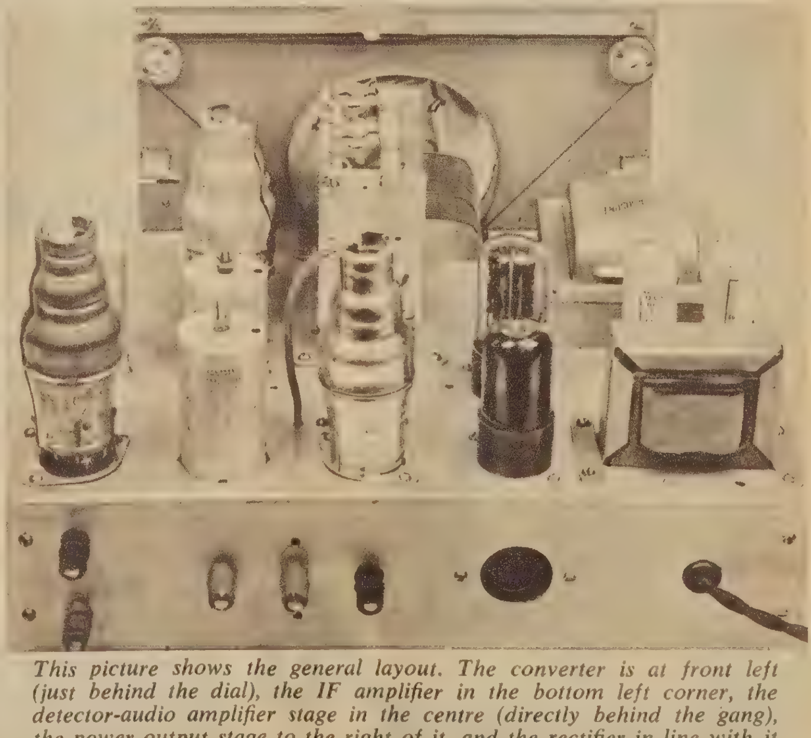
Bias for the converter and IF stage derived from a back-bias resistor in ıe power supply. In addition to the dvantage of cheapness and simplicity 'hich is a feature of this scheme, it has ıe additional merit, in this case, that ıe bias will remain substantially con- :ant regardless of the converter and IF alve types used.

By setting this bias to about three volts will be suitable for almost any type f valve, even though some types can perate on a slightly lower bias. In such cases it will not be possible to realise the maximum gain theoretically possible from the valve, but the loss is negligible in a receiver of this type. All things considered, the arrangement represents an excellent compromise of all the factors involved.

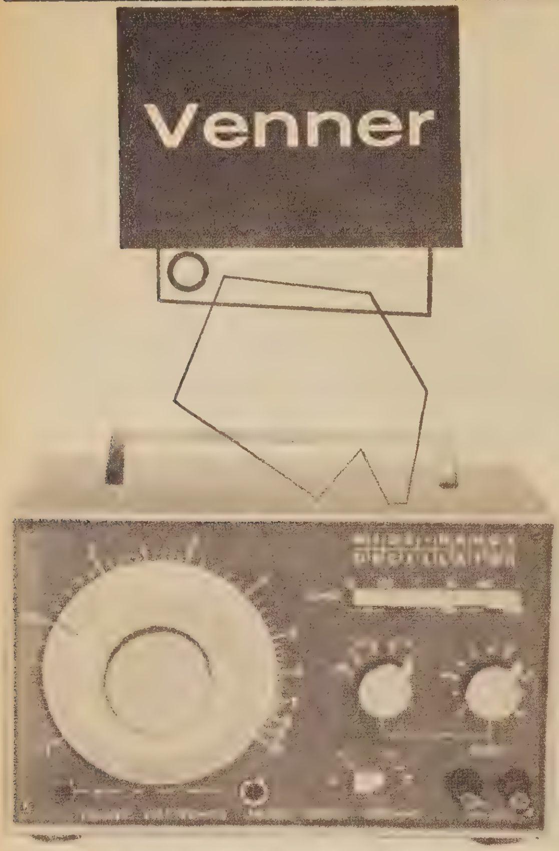
The screen and oscillator plate supply is similarly designed to deliver approximately the same voltage over a wide selection of valve combinations. It is simply a series dropping resistor from the HT line and should deliver between 90 and 100 volts under no-signal conditions. Since three separate elements are supplied from this source, a variation in characteristic of any one would not have a significant effect on the voltage.

Bias for the audio amplifier stage is derived from a 10 megohm grid resistor and has the advantage of functioning virtually automatically over a wide range of valve types. In general, this scheme is satisfactory for pentodes and high-mu triodes. It is less successful with low-mu triodes and this rules out the use of pentodes wired as triodes, unless a cathode bias network is provided.

For the output stage we have specified a cathode-bias system. The main



*This picture shows the general layout. The converter is at front left (just behind the dial), the IF amplifier in the bottom left corner, the detector-audio amplifier stage in the centre (directly behind the gang), the power output stage to the right of it, and the rectifier in line with it towards the front of the chassis.*



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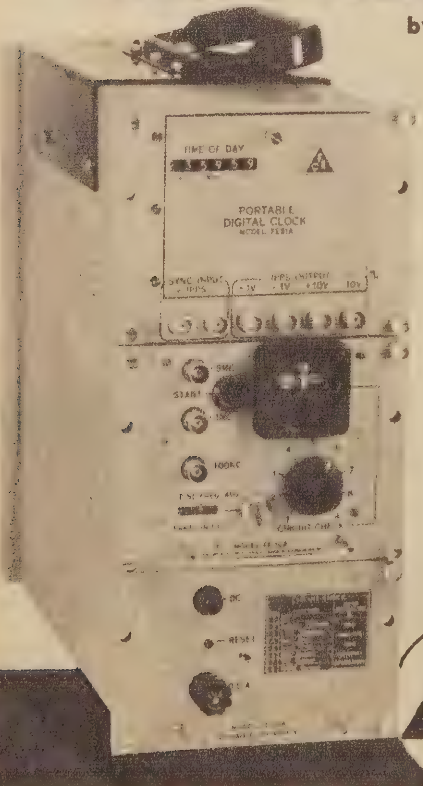

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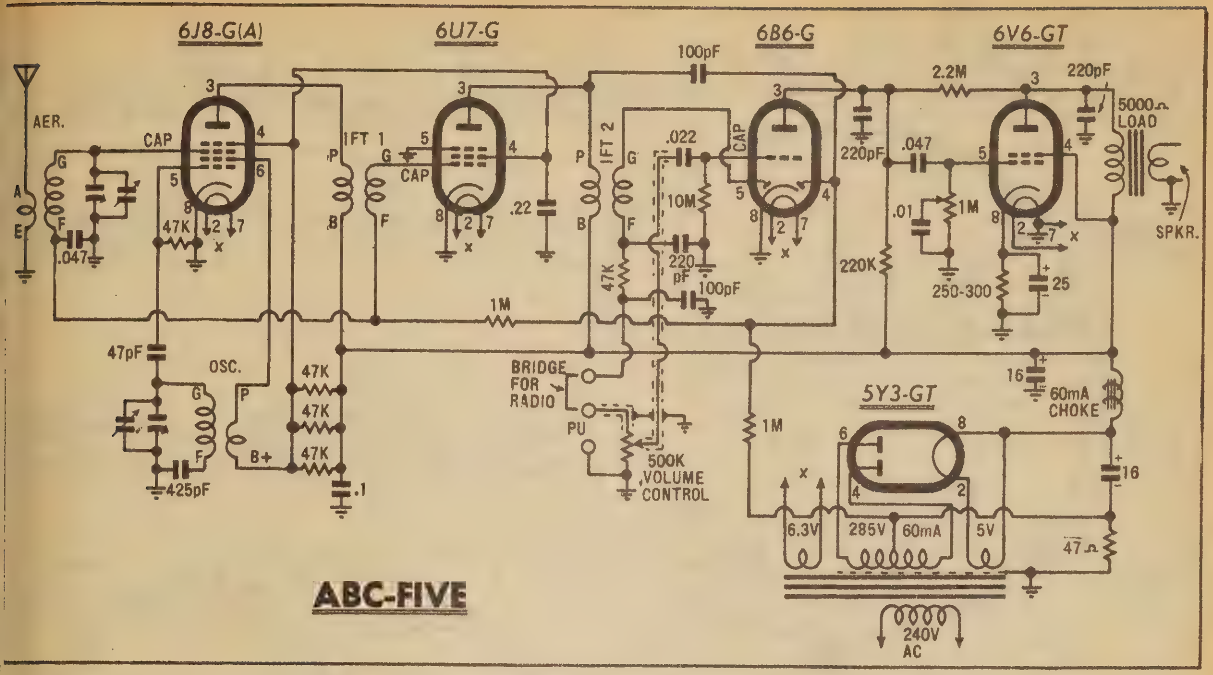

*The circuit is a perfectly standard one, designed for reliable operation rather than the ultimate performance from any particular valve combination. It should have adequate sensitivity and power for all normal domestic requirements.*

reason for this is the fairly wide variety of bias values required for different output valves, varying from 16.5 volts for the older types to six volts for the later ones. This is most easily taken care of when the bias network is independent of any other part of the circuit.

The only other characteristic affecting the output stage is the load into which it is to work. This will be either 5,000 or 7,000 ohms and simply implies the selection of a suitable speaker transformer.

However, the value is not as critical as is popularly imagined and either value would suit most valves quite well. This is particularly so when a negative feedback circuit is employed and it is doubtful whether the purchase of a new transformer would be justified.

The valves we used in the original set are those which we considered most likely, by reason of their popularity in the past, to be found in the average builder's junk box. We have listed alternative types dividing them, where necessary, into two groups.

One is of those valves which can be substituted by simply altering the socket or socket connections. The other covers those types requiring slight alterations to the circuit. These alterations are shown in the group of auxiliary circuits.

For the converter we chose a 6J8, but there are several we can use in place of it. In the 2.5 volt series there is the 2A7 and the 6.3 volt version is the 6A7. The octal version is the 6A8 and these should all work equally well on the broadcast band, even though they have limitations on the short-wave bands.

The 6J8 is better in this respect, being a good all-round performer. The 6K8 is of comparable merit, while the X61M is a comparatively modern valve with a high order of performance.

In the European series we have the ECH3, ECH33, and ECH35. The first two are electrically identical, while the ECH35 differs only in one or two minor points. In the miniature types, the 6AN7 and the 6AE8 would be the most commonly encountered.

All these valves may be used in this circuit without any changes other than those of socket and pin connections.

The only valve of this group which we suspected might call for circuit changes was the 6K8. This has a very high gm triode for the oscillator section and we considered there might be a risk of squegging and similar problems when used with the same oscillator coils as the 68, etc. However, a practical test soon dispelled any qualms and it appears to work quite as well as the other types.

Four other types which may be encountered are the EK2, EK32, and their service equivalents the VR57 and CV1057. For all practical purposes these four may be regarded as electrically identical. The main difference between these and the first group is that they require only 50 volts screen supply.

The circuit alterations necessary for these is shown in the auxiliary circuit. It consists of adding a .068 meg resistor in series with the screen supply and providing an extra by-pass.

For the IF amplifier we chose the 6U7 as being typical, but any of the other suggestions could be used without the need for anything but mechanical changes. (Sockets, pin connections, etc.)

The 58 is the 2.5 volt version, but all the remainder require 6.3 volts. Although they represent a wide range of types with differing orders of gm, they will all work quite happily with 100 volts on the screen and three volts on the grid. Once again we list a couple of service types, which have been readily available.

Coming to the detector and audio amplifier we have the choice of either a pentode or a high-mu triode, both with a pair of diodes for detection and AVC. We chose the 6B6, a high-mu triode,

## PARTS LIST

*1 Chassis 13in x 9in x 3in (Simplified B/C Receiver, July 1950).*
*1 Power transformer 285 volt 60 or 80 mA. 6.3V 2A. 5V 2A.*
*1 60 or 80 mA 30H choke.*
*1 Dial B/C glass suit gang (USL32 or similar).*
*1 Speaker, permag type, size as required. Transformer to suit output valve.*
*1 B/C Aerial Coil.*
*1 B/C Oscillator Coil.*
*2 455 KHz IF transformer Nos. 1 and 2.*

### *VALVES*

*1 6J8G, 1 6U7G, 1 6B6G, 1 6V6GT, 1 5Y3GT, or alternative types. See text.*

### *CAPACITORS*

*Electrolytics: 1 25uF 40V, 2 16uF 350V (one insulated type).*
*Paper or plastic: 1 0.22uF 400V, 1 0.1uF 400V, 1 .022uF 400V, 2 .047uF 200V, 1 .01uF 200V.*
*Mica, plastic or ceramic: 1 425pF (2.5%) 3 220pF, 2 100pF, 1 47pF.*
*2 trimmers, 1 2 gang tuning capacitor.*

### *RESISTORS*

*1 10M ½W, 1 2.2M 1W, 1 1M pot., 2 1M ½W, 1 500K pot., 1 220K 1W, 3 47K 1W, 2 47K ½W, 1 250 or 300 ohm 1 or 3W (See text), 1 47 ohm 1W.*

### *SUNDRIES*

*5 Octal sockets or as required for valves, 3 valve shields or as required. 1 4-pin socket (standard size). 1 4-pin plug to match, 2 red terminals, 2 black terminals, 1 green terminal, 3 grid clips, 1 5-tag terminal strip, 2 3-tag terminal strips, 3 knobs, 1 8-tag terminal strip, shielded hookup wire, plain hookup wire, solder lugs, nuts and bolts.*

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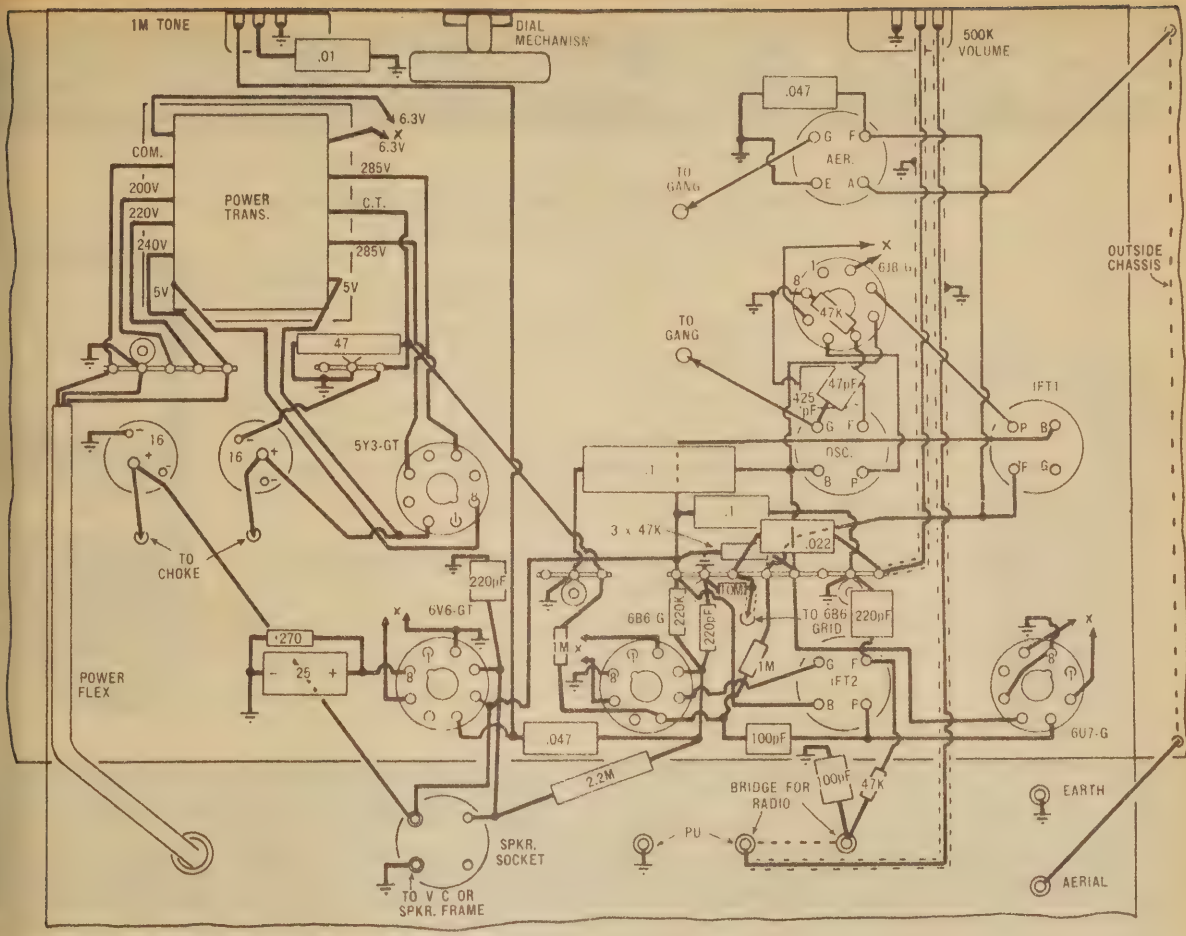

*This wiring diagram, and the photo on page 73, will serve as a guide to the general layout but some changes are inevitable if other valves and components are used.*

nainly because it was about the most opular of this type and the triode rrangement is slightly the simpler.

The 2A6 is the 2.5 volt version and he 75 its 6.3 volt equivalent. The 6SQ7 s a fairly modern version and the BC33 the European type. There are lso two miniature types, 6BD7 and AV6; together with the service types /R55 and CV1055, they will all perorm quite satisfactory with a 10 meg rid resistor and a .22 meg plate load.

To use a pentode it will be necessary o add a screen dropping resistor and creen by-pass capacitor. Although the espective resistance-coupled charts may how slightly different values for some ypes, the suggested 1.5 meg. should be lose enough for all practical purposes. )f the types suggested the 2B7 is the 2.5 olt type, the 6B7 the early 6.3 volts quivalent, the 6B8 the octal version, the BF32 and EBF35 the European equivlents, and the 6N8 the miniature ersion.

For the output stage our choice of the V6 was almost automatic, since this nust surely be one of the most popular utput valves ever made. In its class it nust almost rival the famous 80.

But if your junk box goes back further here are plenty of older types which nay be used, The old .59 when conected as a pentode (grid 3 tied to athode) is electrically similar to the A5 when operated from a 250 volt HT ne. Both these are 2.5 volt types, the 42 the early 6.3 volt version, and the 6F6 the octal equivalent. They all call for a bias resistor of between 450 and 500 ohms and an output load of 7000 ohms.

In the miniature types the 6AQ5 and the 6BW6 are electrically equivalent to the 6V6, except that there is a restriction on the maximum ratings of the 6AQ5. However, this is unlikely to affect this application. The 6BQ5 is similar, but calls for a lower bias resistor, say between 200 and 250 ohms. Load impedance is 7000 ohms.

In the European series the EL3N was a popular choice, by reason of its high sensitivity. This type used a "P" base, but was quickly replaced by an octal based version known as the EL3NG. Later both types were replaced by the EL33, EL33A, and EL33B. All are equivalent electrically, but the last named have minor differences in the provision of an outer sprayed metal shield and its earthing arrangements. The 6M5 is a miniature version of the EL3 and its variants.

They all require a bias resistor of between 150 and 180 ohms and a plate load of 7,000 ohms. Because of their high sensitivity these valves were prone to supersonic oscillation unless suitable precautions were taken. In most cases it was sufficient to fit a grid stopper of anything between 4700 ohms and .047 meg. This can be a half-watt type and should be connected right at the grid pin.

In stubborn cases it is also helpful to fit a screen stopper of 100 ohms. This should also be connected right at the socket pin and may be a one-watt type resistor.

Another very sensitive output valve is the 6BV7. This features a pair of diode plates, but these would be ignored if used in this circuit. It would need a bias resistor of about 120 to 150 ohms and a load impedance of 7000 ohms. The precautions against parasitic oscillation would apply as for the EL3, etc.

It will be noted that we have quoted alternative values for the bias resistor

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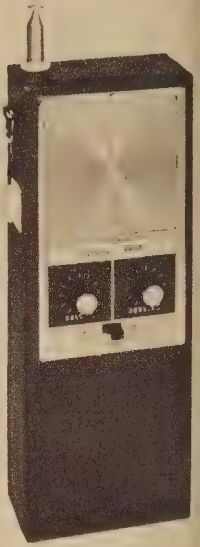

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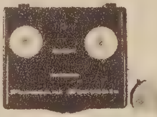

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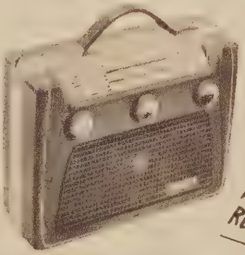

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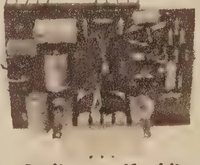

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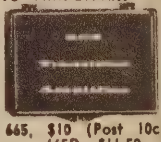

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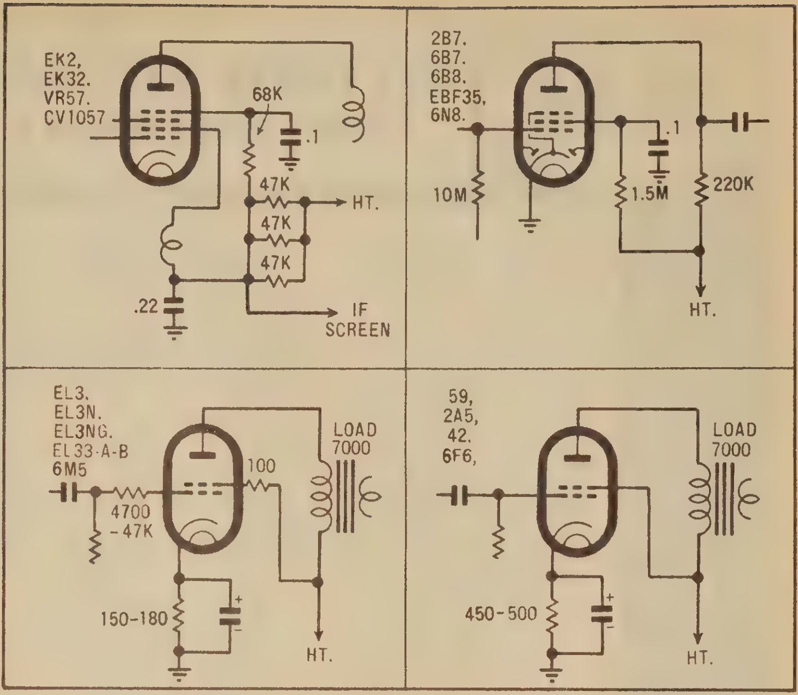

*The alternative valve types listed below, and the circuits shown above, should assist the beginner to make the best possible use of available stocks. Valve pin numbers should be obtained from valve data books.*

for these valves. The lower value is that recommended by the maker and may be used if the power transformer is large enough to supply the necessary current. (Say an 80mA type or larger.) The larger value has been selected on the basis of a 60mA power supply and reduces the current by slightly over-biasing the valve.

This reduces the available power output slightly, but there will still be more than can be let loose in an ordinary lounge room. In these circumstances there is no point in scrapping a perfectly good 60mA transformer and wasting money on a larger one, simply to provide for a possible power output which will never be used.

In place of the 5Y3 which we chose can be substituted an 80, of which there are probably thousands tucked away in innumerable junk boxes throughout the country. A more modern type which could be used if it happens to be available is the 6X5. This will deliver a few more volts of HT but hardly sufficient to call for a dropping resistor.

The 6X4 is a miniature version of the 6X5, and the same conditions would apply. Note that both valves have a current limit of 70mA, and a plate to plate voltage limit of 310 when used with a capacitor input filter. These limits may be important if some older type power transformers are contemplated.

A heavier duty miniature is the 6V4, which should be adequate for any likely version of this circuit.

Rectifiers such as the last three, which have a 6.3 volt filament and an indirectly heated cathode, may be connected to the same filament winding as the rest of the valves or a second 6.3 volt winding if there is one. When only one winding is available, make sure it is large enough to carry the extra current. In most cases this should be so.

Next point to be considered is the mechanical arrangements for the various valves. Since we are assuming the valves are on hand the selection of suitable sockets should not present any problem. However, identification of the base pins is another matter.

Quite obviously data for all the suggested valves cannot be included in the circuit and the logical approach is to refer to valve data books published by the various valve manufacturers.

To cover the older valve types we suggest the Philips Valve Data Book and the RCA Receiving Tube Manual. To cover those purely Australian types the Radiotron Valve Data Book or one of the simpler booklets published by the same firm will be quite satisfactory.

Older American and Australian type valves will invariably require external metal shields on all except the power valve and rectifier. It is more than likely that these will also be on hand with the valves, but if not they may

## ALTERNATIVE VALVE TYPES

| | Converter | IF | Det.-Audio | Power O/P | Rectifier |
|---|---|---|---|---|---|
| May be substituted by altering sockets or socket connections where necessary. | 2A7 | 58 | 2A6 | 6AQ5 | 80 |
| | 6A7 | 6D6 | 75 | 6BW6 | |
| | 6A8 | 6K7 | 6SQ7 | | |
| | 6K8 | 6SK7 | EBC35 | | |
| | 61M | EF39 | VR55 | | |
| | ECH3 | VR53 | CV1055 | | |
| | ECH33 | CV1053 | 6BD7 | | |
| | ECH35 | 6BA6 | 6AV6 | | |
| | 6AN7 | 6BH5 | | | |
| | 6AE8 | | | | |
| May be substituted by making slight circuit changes. | EK2 | | 2B7 | 59 | 6X5 |
| | EK32 | | 6B7 | 2A5 | 6X4 |
| | CV1057 | | 6B8 | 42 | 6V4 |
| | VR57 | | EBF32 | 6F6 | |
| | | | EBF35 | EL3N | |
| | | | 6N8 | EL3NG | |
| | | | | EL33-A-B | |
| | | | | 6M5 | |
| | | | | 6BV7 | |
| | | | | 6BQ5/EL84 | |

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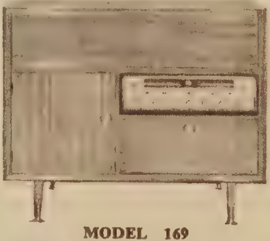
New 1966 models are now available. Can be supplied in "make it yourself" kits.



**MODEL 169**
A compact unit to provide for Player-Tape-recorder-Amplifier-Record and Tape storage. Width: 36in. Height: 24in plus legs. Depth: 18in. Under lids: 35in x 16in and to 7½in high on 1 or 2 levels as required. Amp. space 19in x 5¾in. Storage: 15in x 14in and 19in x 7¾in. Price, complete and polished: $61.00, packing: $2.00. Kit of parts: $39.50, packing: $1.00. Teak veneer $6.50 extra. Free on rail.

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| ELEC. AUST. MAY 1966 | A Battery Charger for your Car. | PT 5786. |
| ELEC. AUST. MAY 1966 | 1966 R-C Bridge | PT2150 |
| ELEC. AUST. MAY 1966 | THREE Band Short Wave Converter | PT5890 |
| ELEC. AUST. APRIL 1966<br>OUTLOOK JULY-AUG. 1965<br>OUTLOOK JAN.-FEB. 1966 | Twin 5 Watt Class A Transistor Stereo Amp. | Z3200 (2 req'd)<br>Z3212<br>PT5755 |
| ELEC. AUST. APRIL 1966 | Protected DC Supply | PT2150 |
| ELEC. AUST. APRIL 1966 | 3 Band Double Change Receiver | PT2062<br>Z3040<br>OT E7/15 |
| ELEC. AUST. MARCH 1966 | Playmaster 113 Stereo Power Amp. | PT5721<br>PT TD19 (2 req'd) |
| ELEC. AUST. FEB. 1966 | A Four Channel Audio Mixer | PT2150 (for AC Supply) |
| ELEC. AUST. FEB. 1966 | Playmaster 112 Transistor Control Unit | PT2150 (for AC Supply) |
| ELEC. AUST. FEB. 1966 | The 1966 Vacuum Tube Voltmeter | PT5890 |
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| ELEC. AUST. DEC. 1965 | A Simple Public Address Amp. | PT1993<br>OT E7/15 |
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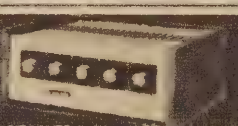

ARMSTRONG 221 Integrated Stereo Amplifier.

**1** Armstrong 222 integrated stereo amplifier. Power output 10 watts push-pull. Frequency response: 30-20,000 c.p.s 1dB Power response 35-20,000 c.p.s 1dB. Harmonic distortion. Less than 0.5 p.c. at 1K/cs measured at 8 watts output 1dB. Decca Deram diamond needle, 2 Goodmans 8in Twinexiette speakers or 2 Wharfedale 8in Super RS/DD speakers Garrard AT6 turntable. PRICE .. .. £109 **$218**

**2** Pioneer SMB 161 11 watt per channel amplifier, 2 Wharfedale 8in RS/DD speakers. Dual 1010 turntable complete with cartridge.
PRICE .. .. .. £105 **$210**

**3** Armstrong 227 10 watt per channel tuner-amplifier P.E. 34 4-speed Hi-Fi turntable with Decca Deram cartridge and diamond needle, 2 Goodmans 10 in. Twinexiette speakers. PRICE .. £185 **$370**

**4** Armstrong 220 stereo amplifier. Distortion Less than 0.1 p.c. at 1K/cs measured at 12 watts. Power output: Ultralinear 12 watts per channel. English best Stereo amplifier and Model 225 pre-amplfier. Dual 1019 turntable with Empire 888P.E. cartridge, 2 Tannoy 12in Dual concentric speakers. PRICE .. .. .. .. .. .. £381 **$762**

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**6** New shipment of full range of Tannoy speakers just arrived. 10in, 12in and 15in dual concentric speakers. Always in stock.

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WHOLESALE AND TRADE ENQUIRIES WELCOME

ave to be improvised. The bases ould be mounted at the same time as e valve sockets.

Almost any material may be used to bricate a valve shield, should this be cessary. Aluminium or tinplate are e two most likely to be found in the me workshop, and the latter may be lvaged from food cans. In fact, if you e lucky, you may find some cans of itable size without further modifica- on.

Most European type valves are al- ady shielded, this taking the form of metallic paint sprayed over the glass ivelope. It is normally connected to ie of the base pins which should be rthed.

Many miniature valves do not re- iire an external shield, but these ould be available if they are required.

Because most of the older type valves ve the grid connection at the top it ay be necessary to modify the first IF ansformer and the aerial coil to pro- de a grid lead from the top of the n. Older coils may already have these it they are seldom fitted to the mod- n types.

Slip the coil out of the can and entify the grid pin. Solder a short ngth of hookup wire to the inner end this pin, pass it through the hole in e top of the can, then reassemble the il in the can. Naturally the coil ould be handled with care while out the can to avoid any chance of maging the relatively fine wires.

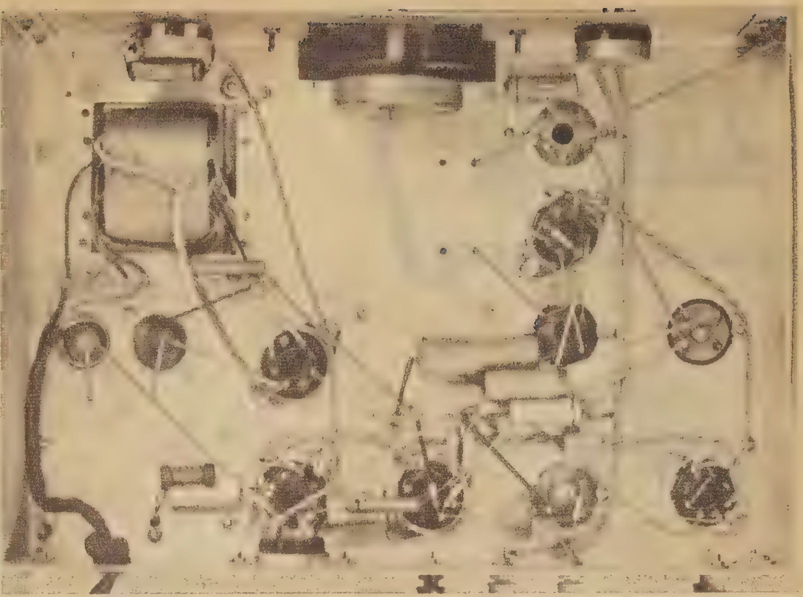
Although we have laid most emphasis the variety of valves which can be ed there are a number of other com- nents which may be salvaged from e junk box. As already mentioned, is possible to use a 60mA power ansformer by using the higher value of as resistor for the output valve. The me remarks apply to the rating of e power choke.

Although a 285 volt type is specified would be possible to use one of the der 385 volt types in conjunction with dropping resistor. You may get away th the scheme of using this in place a choke if you are not particularly ssy about hum level, but a better thod is to connect it in series with the oke. For this arrangement a value 1500 ohms will suit a 60mA drain d about 1200 ohms for an 80mA ain. The wattage rating should be at ist 10, and preferably 20. Mount it ove the chassis to allow the heat to diate.

An even better position for the drop- ng resistor is between the transformer ntre tap and the first electrolytic. In is position less resistance will be re- ired to produce the same voltage drop, ak currents through the electrolytic, rectifier, and the transformer will be s, and less heat will be generated in dropping resistor. The only snag that it is difficult to calculate the act value of resistance required, but should be approximately half the lues suggested above.

It is most important that a 600 volt ctrolytic should be used in the first sition and preferably in the second sition also, when a 385 volt trans- mer is used.

A word of warning here. Do not, in y circumstances, use electrolytics sal- ged from an old receiver. Their capa- ance will be low and their leakage ay have deteriorated sufficiently to en- nger the rectifier and perhaps the power insformer. A set of new capacitors is virtually essential.



*Compare this photograph with the diagram on page 69. Where alternative valve types are used, watch the socket orientation carefully, to preserve short plate and grid leads.*

The gang may be almost any type for which a matching dial can be found and this rules out some of the very old timers. The only way of using one of these would be by using a 0-100 dial with provision for hand lettering the local call signs. Watch the available chassis space if one of these older gangs is contemplated.

The dial itself will probably be salvaged from an old chassis and, assuming that it is mechanically sound and not too dated in style, there is little point in buying a new one. Indeed, this may not be so easy, since there is very little demand for such dials today, and production has virtually ceased. If a dial has to be bought, the most likely source of supply will be those dealers who still have a few old models left on their shelves.

It is also possible that an odd IF transformer, aerial or oscillator coil may be available. If so there is no reason why it should not be mixed with such new ones as are needed. However, the very old types, made before the days of iron cores, are hardly a proposition. In particular, IF transformers with compression type trimmer adjustments can give a lot of trouble.

Some aerial and oscillator coils were made with fixed iron cores, an arrangement which made the coil quite efficient but lacked the advantage of adjustable inductance of the later types. These can be used provided an adjustable padder is used in place of the fixed type, and tracking problems should not be serious provided the gang and dial are matched.

This naturally raises the question of the alignment procedure to be used for various padder arrangements, etc. Since the complete story is too long to relate here, we will simply remind readers that we have available a very comprehensive pamphlet covering the subject and which is available through our query service.

The speaker should be a permag. variety, preferably with the correct type speaker transformer. One of the older electro-magnetic types could be used if it

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can be used as extension speakers or as separate units with communications receivers, etc. Available in three sizes to take 5", 6", or 8" speakers. The housings are of high quality moulded plastic, and can be supplied either separately without speaker, or complete with speaker, as desired.
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The Goldring Model GL88 4 speed unit without arm. Limited stocks only at the give away price of $40.00! Here is the specification: 4 Pole motor—continuously variable speed control—centre spindle of lapped hardened steel—main bearing of sintered bronze—Wow and flutter maximum 0.2 p.c.—Rumble and hum neglible—less than 1 p.c. speed variation for 13 p.c. mains variation—Dimensions—13" x 14¼" —Turntable weight 8lbs. **A REAL BARGAIN.**

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is available, but would call for a 3
volt power transformer. A 1500-o
field was a very popular value and wo
be quite suitable. It would be wi
into the circuit in place of the fil
choke.

Other field values which were us
though less often, were 2000 and 2
ohms. Either value could be u
though, naturally, at the expense of
duced HT voltage.

However, before deciding to use su
a speaker, consider carefully its pres
condition. If it is anything less th
100 p.c. it may not be a proposition
design the set around it, particularly
many of these older speakers can
longer be repaired by the makers.

Constructionally there are not ma
points which require explanation. T
chassis is that originally designed for
Simplified Broadcast Receiver of Ju
1950. This should be readily availa
from your dealer, and its use grea
simplifies the layout and assembly.

However, a point to watch is
orientation of the valve sockets wh
other than original valves are used.
some cases the differences will be sli
and of little consequence; in others th
can be quite serious. You will ha
to use your discretion in this matter
orientate the sockets to suit the parti
lar valve. In some cases this may m
drilling alternative mounting holes.

The two critical leads in all su
cases are the grid and plate leads. Th
carry RF or IF and should be kept
short as possible. The HT and A
leads, on the other hand, are by-pas
to the chassis and carry only DC.
this reason their placement and len
is not critical.

The one exception to this is the c
nection between the AVC diode and
one-meg. AVC load resistor. The di
end of this resistor is "hot" and sho
be kept as short as possible. The ot
end of the resistor is by-passed and
not critical.

We found it beneficial to earth
voice coil or frame of the speaker
this can be quite easily provided
means of a third wire and speaker p
pin. This is mainly a precaution
measure, but is a good thing in p
ciple, since it minimises any chance
oscillation due to small amounts of
in the speaker circuit and which r
couple to the aerial.

The type of power transformer u
will govern the arrangements for wi
to it. Some of the older horizo
types were fitted with terminal boa
whereas the more modern types h
loose leads. In the latter case most
the wires may be wired directly to th
appropriate terminals on various c
ponents. The exception is the prim
connections, which will need a tag s
for their termination as well as the ac
mains leads.

Details of the placement of the mi
components will be found in the wi
diagram and under chassis photogra
These, together with the circuit, sho
provide all the information needed
complete the job.

Regardless of the valve combinati
you use you should have no diffic
in making a first-class receiver, even
oldest valves, if they are in good c
dition, being capable of providing an
pressive sensitivity in a set of this k
So there it is. Haul out the j
box, take stock of what you have,
you may possibly build a first-class
for next to nothing.

# Latest oscilloscopes "think for themselves"

Recent developments by manufacturers of cathode-ray oscilloscopes have added considerably to the already high value and importance of these instruments. This is illustrated rather dramatically by the "self-seeking" automatic/programmable amplifier and timebase plug-ins recently made available by Tektronix Inc. for use with their well-known range of precision laboratory oscilloscopes. With these plug-ins, an oscilloscope virtually "thinks for itself".

*Fitted with the new 3A5 and 3B5 plug-ins, this oscilloscope automatically selects the most appropriate amplifier and timebase range settings.*

The modern cathode-ray oscilloscope is perhaps the most valuable and important measuring instrument available to the electronics engineer and technician, and is a far cry from its crude predecessors of 30 years ago. No longer a device for simply "looking at" electrical goings-on, it is now capable of making precise measurements of voltage, current, waveform and time duration at frequencies ranging from virtually zero (DC) to many gigahertz.

For some years now, in common with other oscilloscope makers, Tektronix Inc. have made available a wide range of precision measuring oscilloscopes for the reserarch and development laboratory. Most of these instruments have provided such features as fully calibrated Y amplifiers, calibrated timebase sweep generators, fully adjustable and delayable sweep triggering, and so on; many have been arranged to accept a wide range of plug-in Y amplifiers, sweep generators and X amplifiers for extended versatility.

However Tektronix have recently extended the plug-in concept still further with their 3A5 automatic/programmable amplifier and 3B5 automatic/programmable timebase, together with the matching 263 external programmer unit. These units are intended for use with the manufacturer's type 561A and 564 oscilloscopes.

*The type 263 external programmer may be used to set the 3A5 and 3B5 plug-ins to one of six predetermined combinations. (This and photo at top of page courtesy Tektronix Australia, Pty. Ltd., 4-14 Foster St., Sydney.)*

With the 3A5 and 3B5 plug-ins, the operator simply presets the plug-in units for a desired pattern height and width — the plug-ins do the rest. As soon as the "seek" button on the special probe is pressed, the plug-ins automatically seek and lock on the appropriate Y amplifier and timebase settings to provide the desired display.

The 3A5 amplfier has a bandwidth of greater than 15MHz (-3dB), from DC, and in automatic modes operates over 12 calibrated ranges from 10mV/div to 50V/div in a 1:2:5 sequence. Additional ranges of 1, 2 and 5 mV/div at 5MHz bandwith are available in manual mode.

In seeking mode, the maximum time required for the 3A5 to complete the seeking operation is 200mS; with the probe button continuously depressed, the system recycles every 2 to 4 seconds. The seeking circuitry functions for signal repetition rates up to 20MHz. Programmable functions include V/div setting, probe attenuation factor, AC/DC input coupling, and vertical positioning.

The automatic seeking in the 3A5 is accomplished by a pair of pick-off diodes in a voltage comparator circuit. If the peak signal voltage exceeds a reference voltage set up by the preset "Trace size" control, a blocking oscillator is fired to advance a ring counter, switching the attenuator to a less sensitive setting. When the signal is attenuated to the point where its peak value no longer exceeds that of the reference, switching stops.

The 3B5 timebase operates on a similar principle. When activated, it starts at the slowest sweep speed and switches to faster rates until it finds the setting giving the preset number of cycles/sweep. In the automatic mode are available sweep rates from 0.1uS/div to 5S/div. Other sweep rates from 10 to 50nS/div are available manually.

On both 3A5 and 3B5 units, readout windows tell the operator which settings have been selected by the automatic circuitry. The readout also tells when the automatic mode is functioning, whether or not the amplifier is AC or DC coupled to the input, whether the amplifier variable control is in the calibrated position or not, and if the probe has been taken into account in registering the sensitivity.

The type 263 external programmer connects to the 3A5 and 3B5 units via 37-way plugs and cables. It holds up to six "program card" printed-wiring boards, selectable by a set of push buttons on the front of the unit. With the six cards set up for the various amplifier and timebase settings required for a series of production tests, changing the settings is a simple matter of pressing the appropriate button.

As may be seen, the 3A5, 3B5 and 263 units extend the range and versatility of the oscilloscope considerably. In seeking mode, an engineer or technician may observe and measure a critical waveform while standing on top of a ladder, leaning inside equipment or otherwise unable to reach the controls; while in the program mode the full facilities of a complex oscilloscope are available rapidly and predictably even to an unskilled operator.

With plug-ins such as these, the modern oscilloscope has surely reached a high level of development. ■

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DC Current: 0-50. Microamps res. 0-25, 0-250 Milliamperes.

Resistance: 0-60K Ohms, 0-6 Megohms.

Capacity: 0-01-0.3mfd (at AC 5 volt 0.0001-01mfd at AC 250 Volt).

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Complete with internal battery, testing leads and prods.

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1 Trans. Amplifier for crystal set circuit supplied.

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| 3 in spools | 35 |
| 5 in spools | 40 |
| 7 in spools | 50 |
| 2½in x 100ft tape | 45 |
| 2½in x 300ft tape | $1.2 |
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|---|---|
| Collaro Rec./play Heads | $8.4 |
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- 3in Meter.
- Handy pocketable size.

**Specifications:**

DC Voltages: 0-10-50-250-500-1,000 V (20,000 Ohms/V).
AC Voltages: 0-10-50-250-500-1,000 V (10,000 Ohms/V).
DC Current: 0-50uA, 0-5-50-500mA.
Resistance: 0-10K, 0-100K, 0-1 Meg, 0-10-Meg. (62 Ohms, 620 Ohms, 6.2K 62K at centre scale).
Capacitance: 0.0001uF-0.005-uF, 005uF-1uF
Decibels: minus 20db to plus 36db in 2 ranges.
Dimensions: 3½in x 5¼in x 1⅜in.
Weight: 15oz approx.
Complete with internal battery, testing leads with prods.

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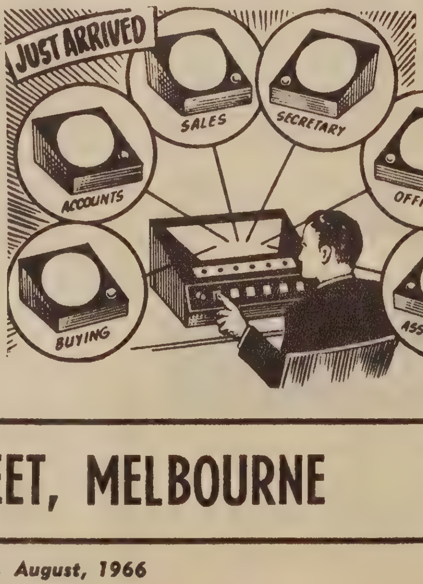

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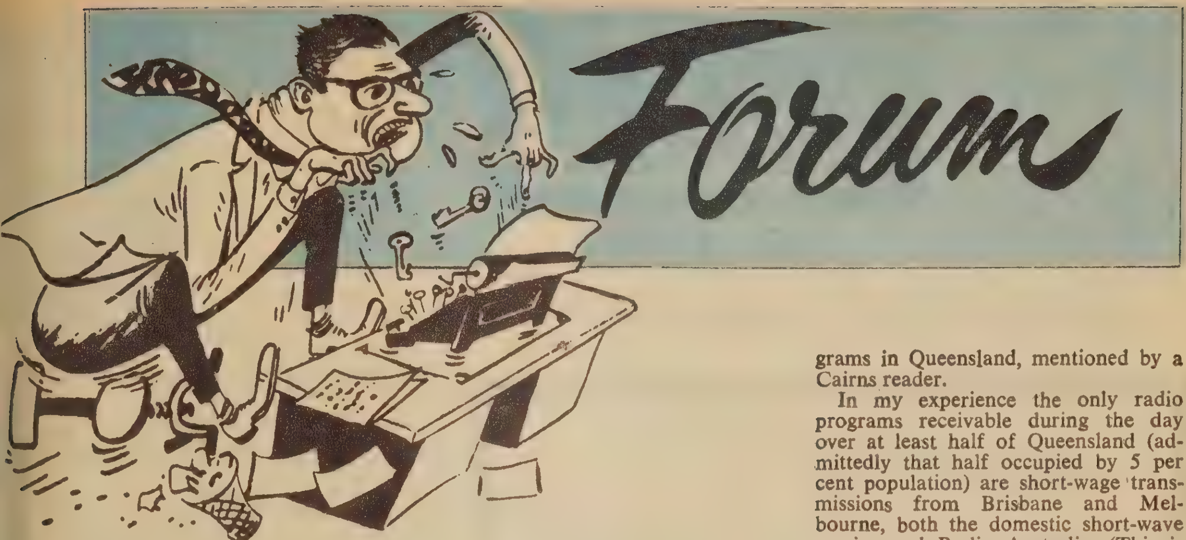
# Forum



Again, this month, we find ourselve with letters on a variety of subjects and with little need to do more than add brief comment. But this surely doesn't matter, provided the letters are interesting and thought-provoking.

### By W. N. Williams

The first letter, from L.D. (Brisbane, d.) continues the discussion about the iability of radio equipment under the oblem conditions encountered by seis-c crews operating in the Australian in-ıd.

It all started, as you may remember, th a reader's blast against SSB equip-nt but subsequent correspondence has ıded strongly to the idea that reliabi-/ is less a question of mode than of sic design. Equipment either is or is not table for certain environment.

And herein, I think, lies the value of ch correspondence from those who ve had extensive experience in the ld. It serves as a reminder to all con-ned with manufacturing equipment d components, that the reliability in-ated in the ordered environment of a oratory, is often quite a different ng from that actually achieved in the d—with the long and unscheduled ex-sure to heat, cold, dust, moisture, bone-king transport and handling by ople who may not exhibit any intui-e consideration for electronic equip-nt.

Our correspondent writes:

The items on SSB versus AM in Forum (May and June) prompt several omments.

Firstly, from nearly five years ex-erience of seismic exploration in Aus-ralia, I can state that service on a eismic crew is a destruction test that ew manufacturers could possibly en-isage. This is true for everything from rawing instruments to motor vehicles nd from air-conditioners to washing nachines. Therefore if one piece of quipment fails where another does ot, this is a glowing recommendation f the survivor rather than an indict-nent of the less rugged equipment.

I have used AM, (HF and VHF) M (VHF) and SSB radios for seismic rews, mainly for communication be-ween field units less than 10 miles part, except for the SSB which was used for communication with Roma and Brisbane, about 200 and 500 miles distant.

The AM radios have been both reliable and unreliable. The reliable ones varied from 10-year-old veterans to brand new transistorised units. The unreliable radios were generally the more pretentious ones.

The FM radios were allotted to a crew which had five of them. In the three months this crew was working for us, I can't remember any time that all five were operating.

The SSB radios are probably the same ones mentioned by J.D. Unfortunately, I have had much the same experience with them. I agree with the comment in the June issue that these sets are obsolescent. But the more modern sets now available cost even more than the $1,400 mentioned.

My own experience (in Central Queensland mainly, not the Simpson Desert) has shown that vibration due to travel over rough roads is more of a problem than dust. Any adjustment that is not positively locked, or any mechanical component not quite strong enough for the job is soon shown up under field conditions. Since AM radios have fewer components and fewer adjustments than SSB sets, the chances are that an SSB transceiver will be less reliable than an AM transceiver.

L.D. goes on to talk about radio reception in country areas, particularly in Queensland. Here again, I think, such correspondence is valuable, even if we think we know all about it.

The fact is that "city folks," with their nearby television and radio stations, record shops, newspapers on the doorsteps, etc., fail to realise that people in the country do not necessarily have this ease of access, either to entertainment or to communication. Nor do they find it any novelty to be "away from it all." Our correspondent continues:

To comment on another subject bought up in "Forum," the radio programs in Queensland, mentioned by a Cairns reader.

In my experience the only radio programs receivable during the day over at least half of Queensland (admittedly that half occupied by 5 per cent population) are short-wage transmissions from Brisbane and Melbourne, both the domestic short-wave service and Radio Australia. (This is using a moderately expensive 4-band 9-transistor radio with large outside aerial).

The fact that the Melbourne programs can be received in outback Queensland indicates that there would be no difficulty in providing two different programs over the whole of Australia from, say, Melbourne using only two transmitters. However, both Brisbane and Melbourne seem to transmit the same program on several different frequencies (with local variations —Melbourne Stock Exchange instead of Brisbane, etc.).

As far as I am concerned, the ideal solution would be both the 4QR and 4QG programs transmitted from Brisbane on several different frequencies with reasonably powerful transmitters. The range of reliable daytime reception from broadcast transmitters in country areas of Queensland is only about 50-100 miles. This is due to topography and low powered transmitters.

Incidentally, have you ever listened to some of the country commercial stations? The standard of program is often even worse than the city commercial stations, if that is possible. The most objectionable I have ever heard is a Western Queensland station that advertised itself as "eleven double noughtable on your portable!" Pretty nauseating after the first half dozen repetitions.

L. D. (Brisbane, Qld.)

So much for communication and broadcasting. Launching now into the realm of linguistics, we acknowledge the following letter:

Dear Sir,

Just a note to thank you for the inclusion in the June issue of the list of German technical terms—most useful to anyone who has, at times, to deal with German equipment and circuits.

However, I must take your author to task for describing the symbol used in some German words to replace "ss" as the Greek letter beta. The symbol used is a ligature of the old long "s" (defunct in English since about 1800) and the small "s". Correctly written it is a combination of these two characters, and rather different to beta.

It beats me why the Germans still retain it.

H.S. (Bulimba, Qld.)

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We turned this one over to our staff mber, Harry Tyrer, who was responle for presentation of the list, at least the form as published. The next two agraphs are his:

H. S. is quite correct in his assertions. wever, since the Greek letter beta is ficiently like the German "ss" symbol pass muster, and is available on our otype machines (whereas the German nbol is not) we decided to stretch a int rather than to enter on the almost possible task of trying to explain the m of the correct symbol. With the lanation given we felt sure those of r readers who encountered the symbol the first time would have had no ficulty in identifying it as a double

The reason for retaining the special m of the double "s" in German is ply explained. It is common practice German to join a number of words ether to make a single expression. ite often these conglomerate expresns contain a word ending in "ss" folved immediately by another word bening with the same letter. A common ample of this is the expression aβstab" meaning a standard of comison (Maβ equals measure and "Stab" als rod). It is apparent that without special form of the "ss" the expresn would have three consecutive ses." In English we avoid this by the of hyphens.

## IENCE, SPECULATION?

Reproduced in the adjacent columns a letter, slightly abridged for space sons, from John W. Campbell, editor "Analog" magazine.

This letter is the outcome of discusn in the November issue, last year, l in February and March this year, the subject of electro-medical gads. In the March issue, we published etter from Mr Campbell lending his port to electro-medical gadgets and ving a go" at scientists who allegedly l give no credence at all to things y could not immediately explain.

n commenting on this first letter, I ried the accuracy of certain sweep. statements and the technique of oving" others by referring to situas which are allegedly (but not necesily) parallel.

This present letter is in reply to my arks and should really be read in junction with pages 49 and 51 of the rch, 1966, issue.

n reproducing this letter, it is not my ntion to perpetuate the argument ut electro-medical gadgets; no ount of discussion at "forum" level is ly to make much difference to sent points of view.

My thought, rather, is to afford right reply to Mr Campbell and, in so ng, to give him opportunity to air views on fact, fiction and specula-

imagine that such views as he exsses are an asset in producing a gazine which admits a large amount science fiction into its pages. In ing this I am not ridiculing science ion, as such; one of our former staff nbers was quite an avid reader of nce fiction journals—"Analog" inled.

Undoubtedly, much that has appeared science fiction literature in the past oday fact; and much that is fiction y will be fact tomorrow.

ut equally, I imagine, much of what

## DOES SCIENCE STIFLE SPECULATION?

*Dear Mr Williams:*

*One of my readers spotted the letter from me to "Mr A" in your Forum, and sent it along to me. You've misunderstood some of my points.*

*First, my degree is in physics; I started writing science fiction while a freshman at M.I.T., because science fiction is an area in which speculation is permitted and encouraged — and mankind advances only by first speculating, then testing. My work since has been largely science fiction, but I also do scientific consultant jobs, largely in electronic devices.*

*Science is limited in one basic phase; by definition it consists of an organised body of knowledge. It cannot include in "science" areas which are disorganised and therefore un-understood. Thus any not-yet-understood phenomenon is "unscientific" by the definition. That does not make it unreal. But a scientist will deny its reality — because most scientists quite honestly feel that "science" and "real" are in one-to-one correlation.*

*Thirty years ago I was told that spaceships, atomic bombs and atomic power plants were nonsense— fantasies — pseudo-science. My chemistry professor at M.I.T. deplored my "prostituting my science" in that fantasy stuff about life on other planets. In science fiction, my business is taking a hard look at the next horizons in science — which always disturbs the limited-by-definition scientist.*

*Science has not studied subjective reality; what you refer to in your Forum answer is NOT a study of subjective reality, but a study of HOW TO ELIMINATE ALL POSSIBILITY OF SUBJECTIVE EFFECTS in experiments. Objective science seeks to demonstrate that a phenomenon is purely objective; much effort has been devoted to developing means of excluding subjective effects.*

*This is studying subjective reality? On that basis, the way to study bacteria is to develop techniques that will totally eliminate all bacteria from the area we're going to study, and THEN begin our study.*

*Cast your mind back to 1930, and imagine the reactions of the scientists of the world if presented with a modern radio-controlled drone reconnaisance plane, with on-board microminiaturised computers, which has just come back from sniffing the Red Chinese mushroom that grew over one of their nuclear weapons tests.*

*It's obviously impossible — an elaborate hoax for some stupid and pointless reason. Everyone knows perfectly well that barium, strontium and manganese, cobalt and sodium, simply aren't radioactive — can't possibly be. Scientific nonsense.*

*And obviously that piece of stovepipe open at both ends can't be an engine. And these shoe-button things pretending to be electronic amplifiers . . . ! Sheer nonsense. Impossible. Analyse 'em and they're nothing but silicon, and carefully made duplicates don't amplify which proves they're nonsense.*

*Subjective phenomena, such as telepathy, are theoretically impossible today. But you know, perhaps, of the recent work in Czechoslovakia in which message transmission between two volunteers by telepathy was handled mathematically by Information theory as a problem in message transmission down a very noisy channel . . . and they proved 95 per cent reliability? It took a very high redundancy to achieve it, but they demonstrated solidly that they had done so.*

*And you have probably seen the results achieved testing identical twins for telepathic information transfer, by attaching them to electroencephalographs, and showing that when twin "A" closed his eyes, twin "B," in a well-removed room, showed up with the typical closed-eyes Alpha rhythm? It doesn't count of course, because it didn't happen with all the twins they tried — only with two pairs out of seventeen pairs.*

*Ever tried to tune up a parametric amplifier yourself? I have — and believe me, I KNOW parametric amplifiers are impossible. Any reports that they actually work are obviously hoaxes; I tried just what they said you should do, and it was absolutely impossible to make it work. You can ask any man who's tried meshing one of the damnable little recalcitrant contraptions into phase, and at least 99 per cent will tell you they absolutely WILL not work.*

*Why do you expect a completely unfamiliar, un-understood phenomenon to work with the regularity of something as thoroughly worked out and understood as a triode vacuum tube audio amplifier? De Forest's weren't so hot; they sold the ones that happened to work, and junked the rest, and simply charged the customers for all that they made. 1900 style automobiles weren't much better than modern telepaths, either. What right have you for demanding perfection-or-it-doesn't-really-exist?*

*And science, having spent several centuries trying to develop techniques to supress subjective efforts in their experiments — well, naturally, scientific laboratory techniques so carefully developed are precisely the wrong techniques for studying that type of phenomenon!*

*Incidentally the "electronic" gadgets I've seen were demonstrated to me as pest-eliminators. I don't know how one goes about inducing a Japanese beetle to believe that the little black box will kill him; how an Aborigine can be induced to believe the bone-pointing will lead to his death I can understand. But I wonder how they induce 98 per cent of the Japanese beetles in a field of corn to believe the little black box can kill them? Or even make them realise the thing's there?* J. W. Campbell.

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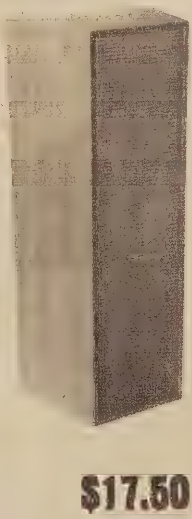

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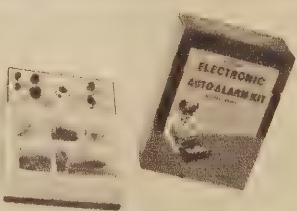

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## MORE SUPPORT FOR MORSE CODE

*Dear Sir,*

*In "Forum" in the July issue of "E.A." you published a letter from someone at Flinders Naval Depot, supporting the use of hand-sent Morse. As the R.A.N. representative of the Royal Naval Amateur Radio Society I would like to get in touch with this person, who has shown sufficient interest in amateur radio at least to criticise it. The Australian section of the R.N.A.R.S. badly needs more members to become a viable entity, and although it has been publicised through official channels, and in your own pages, there has been little response from within the Service.*

*I would like to take this opportunity of supporting the case for hand-sent Morse. Although my HF-band operation is now primarily on SSB, I have no beam antenna and often have a struggle to compete with the "California Kilowatts"; under these circumstances I frequently find solid contacts obtainable on CW, when I can scarcely raise a reply on SSB. Although in all Service voice communication systems SSB is rapidly replacing AM, the fact remains that the bulk of signal traffic is carried by telegraphy, increasingly by teletype, and even with universal use of teletype there will still be need to maintain the capability of sending and receiving Morse by hand.*

*This point has recently been made in an issue of the "Communicator," the Royal Navy signals journal. Retention of Morse skills is particularly important in a fighting service where equipment, no matter how reliable in peacetime use, is liable to battle damage; essential communications may ultimately be saved by the ability to key by hand an improvised source of RF, and the ability of someone else to copy the result.*

*In purely amateur operation the retention of a basic Morse capability is no less important, in view of the frequent use of the Amateur Service in emergencies. WICEN traffic is handled by telephony because the type of equipment used, and the proportion of limited licensees among the operators, makes it the speediest and most convenient mode as long as the gear remains intact.*

*Nevertheless in the ultimate emergency, after a nuclear attack for example, wrecked apparatus would have to be salvaged and put on the air in the simplest and quickest way possible, and the most bigoted SSB enthusiast would be reduced to signalling by turning his carrier on and off, assuming that he can remember the code and that there is someone listening who can read it. From the civil defence point of view, at any rate, anybody who is capable of building a transmitter or receiver from salvaged parts should gain and maintain at least moderate skill in sending and reading Morse.*

*Many years ago I read an account in an overseas radio magazine of a type of amateur radio contest which might well be worth repeating. It was, I think, in a Scandinavian country: the contestants were ferried to a small, uninhabited, island in a lake, and left with a number of old radio chassis and a limited range of hand tools; the winner was he who first established radio contact with a station on the mainland. I do not remember the result, but surely the winning signal was CW rather than SSB or even AM.*

*S. J. Lloyd, Surgeon Commander R.A.N., VK3AST,*
*Department of Navy, Victoria Barracks, Melbourne, S.C.1.*

---

been written in the past has not n transformed into fact and, for all know, may never be.

And herein lies the basic weakness of Campbell's apparent love of "prov-" things by comparison. Granted that ny people would have ridiculed space os, microcircuits, etc., in the early 0s; but that certainly does not prove all things that are ridiculed today become fact tomorrow.

They may or they may not, depending whether the proposition is based on h as yet "undiscovered."

also wonder whether "scientists" can collected into the neat bundle that Campbell apparently visualises and nded by such terms as "text-book erts," "non-visionaries," "academic ckers" and so on.

Did all scientists, in fact ridicule ce ships and other futuristic ideas 30 rs ago?

re present-day scientists completely ware of things that might emerge in next 30 years?

Vhat are the relative merits of build- knowledge upon knowledge, or ely guessing, or of following an rmediate path which I have heard cribed as "guesstimating?"

ne could go on posing questions but ppose it boils down to this: There is m in our thought processes for specu- n, observation, postulation; for re- ch, proof and fact, so-called. I find emphasis which Mr Campbell places various aspects unacceptable.

ut then, I'm only me!

mong letters recently to hand was from H.C., Australian National Uni- ity, Canberra.

Vritten in challenging tone he says, ngst other things:

"I have been a reader of 'R. TV. d H.' and 'ELECTRONICS Aus- alia' for 12 years. When the change om valves to transistors began in rnest about 1962, I hoped that the aff of your magazine would eventu- ly get used to transistor techniques.

"Now, in 66, with integrated rcuits, FETs, UJTs and SCRs, well tablished in their fields and being oduced on a 1,000 billion dollar vel, my colleagues and I just cannot derstand how your staff can con- antly ignore these developments.

If your average reader knows any- ing about FET-UJT-SCR circuits, is certainly not through any descrip- ve articles in 'ELECTRONICS Aus- alia.'

"Since nobody in his right senses n ignore progress in any field, there pears only one possible explanation r the matter: 'ELECTRONICS Aus- alia' has not been able to attract aff with modern training and an abi- y to understand and design modern rcuitry.

"There are many able and brilliant ectronic designers in our country and should therefore be no problem to t the level of your publication.

"I do not ask for articles on specia- ed or even very recent circuitry but u could have treated your readers ars ago with some modern circuitry ited for home building.

"To name a few: A UJT timing cuit with time delays to five hours; transistorised oscilloscope which uld not cost more than a valve one; ransistorised tape recorder; a VTVM ng FETs. I have been offered Ts for $1.00.

"You could have featured a heavy duty variable power supply AC or DC using no variac but simply SCRs. A garage door-opener is overdue.

"For the near future, you could ask some of the leading electronics men in the industry and universities for help on urgently needed up-to-date articles. I am sure all will help."

In closing, H.C. says that, if we have the nerve to publish this letter, it should start a revolution!

I doubt it, H.C., although one usually stands to learn something from criticism.

But, frankly, it is news to me that we have ignored solid state devices. It would be an interesting exercise to plot our use of solid-state versus thermionic devices, over recent years. I doubt that it would support H.C.'s statement. In fact, other readers are not beyond reminding us that they still have valves in their spare parts boxes which they like to use on occasions!

On the subject of miniature circuit techniques, one could refer to a two-part survey of this subject by a writer from the University of N.S.W. in August and September last year, with a look at future techniques in June issue, last. Readers who studied these articles, as a background to many other references, would not be entirely ignorant of miniature circuit techniques.

As for specific devices, I could recall the article we featured some years ago from the General Electric Company on Tunnel Diodes. By their reactions, it was the first time that many local engineers had heard of such a device!

As for FETs we could refer our correspondent to an "Answer Man" feature in September, 1964, explaining their general principles and giving the circuit for a typical FET voltmeter.

The unijunction transistor (UJT) was explained in the February, 1966, issue and used as the basis for a Morse oscillator. It was mentioned again as a simple relaxation oscillator in the Veroboard series in March and as a crystal oscillator in "Calibration Techniques" in the June issue.

This scarcely amounts to ignoring it!

Our correspondent's letter has pointed up one obvious fact, however, that we did not distinguish the UJT with a special heading and one can hardly blame him for not seeing it.

SCRs were featured in the "Variwatt Power Controller" in January, this year, and the "Varitach Motor Speed Con-

(Continued on Page 93)

# PALACE 8-WATT STEREO AMPLIFIER

SELECTOR
LEFT VOLUME
RIGHT VOLUME
TONE
STEREO AMPLIFIER
SA-80S

## MODEL SA-80S

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---

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All four inputs accept standard two circuit Phone Plugs, while the output jack accepts a standard circuit Phone Pin Plug.

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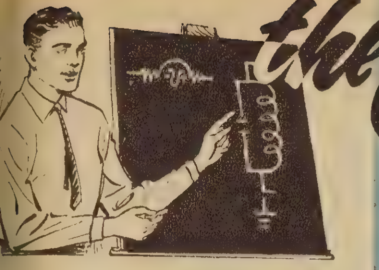

# the "Answer Man" Explains

## Bulk eraser, variable resistor, etc.

The Answer Man has been called upon, this month, to deal with a number of questions on quite different subjects. The first question raises once again the matter of bulk erasers for recording tape.

**I have been waiting patiently for you describe a bulk eraser for magnetic pe. Surely it shouldn't be all that fficult?**

Let's face it—it is difficult. Sitting ound somewhere are about three ototypes of bulk erasers that didn't ork—or, at least, not well enough for to run as a project.

But, in case some readers may not too clear as to what the term means, should, perhaps, pause to explain.

A bulk eraser is a device which nerates a powerful alternating field, ually at mains frequency, which is intended to erase all signals from a reel recording tape when the two are ought together.

The value of the scheme is that one n "clean" a tape, for privacy reasons, a few seconds, instead of having to n it through a recorder, erasing the e a track at a time, with the records normal erase facility.

It is also valuable when one wishes make a recording on a quarter-track chine which is later to be played on half-track machine. Bulk erase allows vestige of the previous recording to removed so that the half-track chine does not reproduce material ich the quarter-track erase leaves act.

On the other hand, of course, bulk se is of no use when it is desired preserve some of the program on tape. It is a case of all or nothing!

A bulk eraser normally consists of winding on one leg of a set of open nsformer laminations—say, the "E" ninations without the "I" laminations. ce the magnetic circuit is open, the gnetic field loops across the interven- space between the lamination faces it is in this area where erasure can e place.

The first bulk eraser we ever handled s a commercial unit fitted with a ing switch, which one held in the d and rubbed over the face of a reel tape.

The job had to be done very roughly, taking care that the face of eraser was rubbed in a looping hion, round and round over the entire e of the reel—and on both sides of reel. If it was not done thoroughly, would later find segments of the tape h some of the original signal remaining, which was disturbing, to say the least.

But, even with care, erasure was not always complete with certain classes of tape and particularly when it was wound on a spool having thicker than normal walls, which kept the tape away from the pole faces.

With the co-operation of one of the local transformer manufacturers, we built a unit of this type, but we were no more happy about it than the original one and it's still sitting around somewhere as a prime example of a bulk "almost-eraser."

The obvious reaction is to design such a unit with a more generous stray field, but this isn't as easy as it sounds. Because the magnetic field is open, the inductance of the winding tends to be quite low and therefore the current through it quite high. In seeking a stronger erase field, one very rapidly runs into excessive current and consequent heating, which is the very reason why such units are generally fitted with spring switches.

You can't inadvertently leave them on.

In an effort to take the chance out of sweeping an erase coil manually over the tape spool, we later built up a desk unit containing two sets of facing laminations. The idea was for the spool to be lowered into the space between the laminations with a short length of rod acting as a temporary spindle, rotated slowly for a few turns and withdrawn while the AC circuit was still closed.

The thing worked fine for small spools, but not nearly so well with the larger 7-inch variety. We tried different spindle positions to scan the spool surface to best advantage and we tried a sliding spindle locus, both without achieving complete reliability.

We resorted to bigger laminations and higher current and it was here that the transformer manufacturer, who had been supplying the hardware, warned us that we were thinking in terms of quite expensive assemblies; that we were virtually asking them to supply two big iron-cored chokes with special metalwork to hold them together in view of the half-laminations.

That's when we put the thing back under the bench on the assumption that, however much some readers might like a bulk eraser, they didn't want it that much!

Maybe we could have done better with laminations specially proportioned for this particular job in mind, but nothing like this appeared to be forthcoming.

In the meantime, we have the gravest doubts when we see do-it-yourself articles describing bulk erasers along the very lines we rejected. Undoubtedly they'll erase most of the reel most of the time, but that's hardly good enough.

1
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It's a bit too much like magnetic ulette!

In short, the need is for a unit which ll reliably erase all classes of tape reels up to 7-inch diameter, not for- tting the outermost layers nor those the centre of reels with small hubs. any reader has built such a unit, cap- le of economic reproduction by other aders, start writing. We'd like to know out it.

★ ★ ★

**In your "Answer Man" on page 59 of e June issue, you recommended a 10- tt 12 to 15-ohm resistor to control e brightness of two 12-volt 20-watt obes. You worked it out in some detail r the dimmed condition but what out the condition where the lamps re operating at nearly full brilliance? ould not they be drawing something proaching 3 amps through a resistance ement which, on the basis of a 10-watt ting overall, would more likely have a rrent limit of about 1 amp?**

At first appearance, our correspondent quite right and we should not be sur- ised at him having taken up the point. It is quite true that the maximum rmissible current through any portion a variable resistor will not be sub- antially higher than the current which ould flow when the maximum permis- ble wattage is being dissipated by the tire resistance element.

The fact that it might be higher by en a small amount rests on the assump- on that there will be some heat dissi- tion from sections of the resistor ljacent to the section carrying current, id that this will help matters to some tent.

The calculations in the June issue sumed a current of about 1.0 amp and voltage of about 9, leading to the sug- stion of a minimum rating of 10 watts r the resistance element. However, as rightly pointed out, it is equally rea- nable to assume that the design of the -watt resistor would impose something e a 1.0 amp limit on current through y portion of the resistance element, so at about the nearly full-on position? Would not that end of the resistor reaten to burn up, while the opposite d remained coolly intact?

As might be expected, we quickly ught out the staff member who had itten this item but, before sending him to the corner, with head hung low, we ve him 10 seconds to explain.

In fact, he did have a simple explana- n. The question was based on a ecific problem presented by a reader io made it clear that he wanted to vary lights smoothly between two desired ites: Full-on and virtually off. He did t need to operate the lights for any nificant length of time at an inter- diate brightness.

This is a fairly familiar situation in nateur dramatics where, with equally nateur equipment, producers seek to mic big-time shows by fading lights her than simply switching them off. often as not, the fade system will not rry the load for any length of time the dimmed condition and serves her as a graduated switch.

This is what was sought in the particu- instance.

Unfortunately, in writing up the prob- n, our staff member did not include s vital point. The undeniable fact is it, as it stands, the item must be taken a boo-boo on our part, so it's into the ner for this particular staff member!

---

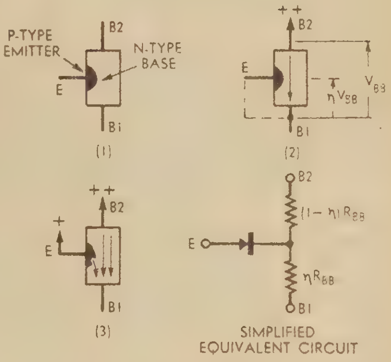
# KEEPING UP WITH semiconductors

## . . . the Unijunction or UJT

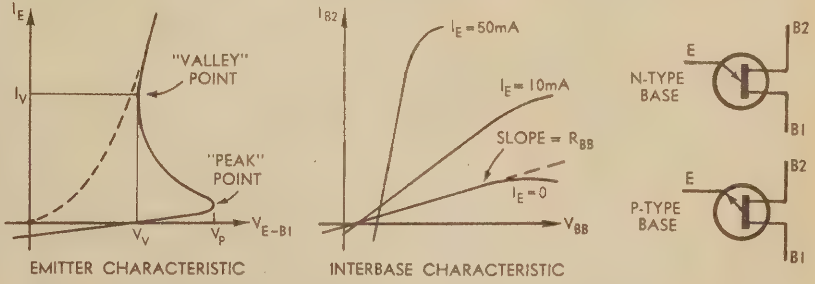
As its circuit symbol would suggest, the unijunction transistor or UJT is quite a different device from normal two-junction transistors. In fact, it is closer to a diode than a transistor, and has been called the "double-base diode."

In construction, the UJT consists of either a small rectangular bar or cube of N-type (or alternatively P-type) silicon material, with a non-rectifying or "ohmic" connection at each end. The bar or cube is termed the "base" because of its similarity to the base wafer of a normal transistor; the two base connections are labelled B1 and B2.

To the side of the bar or cube, between the two base connections, is alloyed a pellet of P-type (or N-type) material, forming a single P-N (or N-P) junction—hence the name "unijunction." The pellet is called the emitter and its connection labelled E. Figure 1 shows the basic idea.



*Three diagrams used to explain UJT operation, together with the simplified equivalent circuit.*



*The static emitter and interbase characteristics of an N-type base UJT, illustrating the points discussed in the text. Note the schematic symbols.*

Either of the two base connections of the UJT may be used together with the emitter connection as a normal rectifier diode which will conduct if the emitter is made more positive than the base but will become a virtual open-circuit if the base is more positive than the emitter. However, a voltage applied across the base to make B2 positive with respect to B1 gives the emitter-base junction an inbuilt "delay bias."

This is because current flowing through the base from B2 to B1 sets up a voltage drop in the semiconductor material and raises the potential of the base region in the immediate vicinity of the junction. Thus as far as the emitter is concerned, the base becomes positively biased, and conduction cannot take place until the emitter is raised above the effective base potential.

If Vbb is the total B2-B1 voltage, the effective base potential is given by a fraction eta of Vbb, where eta is the proportion of total interbase resistance Rbb effectively between E and B1 (see figure 2). Conduction occurs at the "peak point" (figure 3), when the emitter voltage is raised above this effective base potential by an amount sufficient to cause forward conduction in the P-N junction: approx. 0.7V.

But the UJT is more than a diode with "built-in bias," for as soon as the emitter is raised to the potential which initiates conduction through the junction, it injects minority carriers (holes) into the N-type base material. These have the effect of increasing markedly the conductivity of the base region between the junction and B1 — thus the resistance of this region drops sharply.

Because of the drop in resistance the current between B2 and B1 increases and current amplification occurs because the increase in B2-B1 current is considerably greater than the small emitter-base current. Not only this, but the fall in resistance of the junction-B1 region produces a falling emitter voltage with increasing emitter current — so that the effective input resistance of the emitter-base junction becomes NEGATIVE (see curves).

Because of its ability to act as a high current-gain switch and as a negative resistance the UJT is finding increasing use in triggering and relay circuits, in pulse shaping circuits and in many types of oscillator. Articles describing UJT circuits were published in our February and June, 1966, issues.

# The Serviceman

## SYMPTOMS: TO LEAD OR MISLEAD

The purist may contend that all symptoms should be helpful, if only we interpret them correctly. Which is all very well in theory, but any serviceman will confirm that there are plenty of symptoms which are more hindrance than help. Several stories this month emphasise just how difficult correct interpretation can be.

The first one tells of a set which led me a merry dance for a while; partly because of its unusual symptoms and partly because of an oversight on my part. Together they created quite a sticky situation.

The customer's complaint was that after the set had been playing for some time, ". . . the picture went dark on the right-hand side," to use his own words. As far as I could determine, the sound was still normal, as was the picture, or as much of it as was still visible.

Unfortunately, the trouble turned out to be a bit erratic. The first time I visited the house, the set flatly refused to misbehave at all, at least within the time I could spare to watch it . At that stage I had the choice of talking it back to the shop and letting it run until it failed, or leaving it with the customer in the hope that the next time I called it would be more co-operative. For a number of reasons, including the fact that the owner hoped to watch a certain program that night, it was mutually agreed to leave it for the time being.

About a week later I received another call from the owner saying the trouble appeared to be getting worse — and more consistent — and he thought I should now have no difficulty in observing it anytime I liked to call.

He was right. Within minutes of switching on, the screen began to darken on the right-hand side. What picture remained appeared more or less normal, although perhaps lacking contrast a little. The sound remained quite normal. I decided to tackle it on the spot, before it decided to cure itself.

My initial reaction was that the trouble could be in the horizontal retrace blanking circuit, or one of the electrolytic capacitors in the main filter or decoupling networks. If the latter was the cause, it should be a simple matter to find it by bridging with a new one and I could replace it and be on my way in half-an-hour.

Oh yeah!

I checked the re-trace blanking circuit and could find nothing abnormal, so it seemed most likely to be the electrolytics. But after I had checked every electro in the chassis, and found precisely nothing, I began to fear that the set would have to go back to the shop. Then, like the poker machine addict hoping to get his money back, I decided to have one more try.

More or less on spec, I went over the chassis with the VTVM, looking for any abnormal voltages that might give me a clue. Eventually I found one, but it didn't seem likely to be very helpful. It was in the last IF stage and, far from clarifying the situation, only turned out to be a puzzle on its own.

Superficially, the problem seemed simple enough, at least in itself. The screen of the valve had only 20 volts or so on it, and I naturally assumed the most likely cause would be a broken down screen by-pass capacitor or a faulty screen dropping resistor. In fact, it turned out to be neither.

Then I tried a new valve on the assumption that the original may have had an internal short or some other defect. Still only 20 volts. Next I checked the voltage with the valve removed from the socket, just in case there was something silly wrong with the socket, like a sliver of solder between the wafers. However, the voltage rose to the full HT value.

What about positive voltage reaching the grid in some manner, thus producing excessive screen current? A check with the VTVM showed virtually no voltage, thus knocking out that theory. However, purely on spec, I switched the meter to the AC range and tried again. This time I read about 3 volts AC, which I could hardly expect to be 30MHz signal.

Right at that moment I could offer no explanation for this, particularly as I was still not sure whether I was observing cause or effect, or whether I had two separate faults. Then, to cap it all, I suddenly realised that the picture had completely disappeared, leaving only the shaded raster, and that the sound quality seemed to have deteriorated.

That settled it. I loaded the chassis onto the truck and headed for home. If I was going to be made a fool of by some crazy fault, I preferred to suffer the experience in the privacy of my own workshop. Besides, I could think a lot clearer on my own!

With the set on the bench, I went over most of the things I had checked in the customer's home — and came up with precisely the same answers. Then I tried some new approaches, like the AGC system, but could find nothing very helpful. Finally, I just sat down and thought.

This didn't seem to produce anything very helpful either, but I did decide that it might be worth checking the video detector. This was a diode mounted side the last IF can but, by lif appropriate connections, and selec suitable pins, one can usually gain ac to it and make forward and reverse r tance measurements.

This I did, and came up with a vi short circuit in both directions; the conclusive symptom I had found However, I had no way of kno whether this was the complete ans or only part of the story. Was the d partly defective right from the star was this a new fault which had d oped after I started work on it?

Fitting a new diode soon clarified point. It restored the sound and the ture, but did nothing to cure the sha or restore normal screen voltage to last IF stage. So I was back whe started from.

Once again I sat down and thou In the back of my mind there rema the conviction that the trouble coul most logically explained by a filt fault. Yet I had bridged all the ele lytics with a known good one, wit producing the slightest change in b haviour.

I fished out the circuit diagram took a long hard look at it, hoping some inspiration. Then I found m toting up the various electrolytics I had already checked and sudd realised that there was one I h checked. It was, in fact, one sectio the voltage doubling network follo the rectifiers.

I took another look at the ch and realised why. It was one of in a single can and the terminal very effectively obscured by a large tor. Hence my omission to check i defence of this oversight, I can say that, while I was moderately fam with the chassis involved, it was not of my most common types, plus the that I had never before had occasio check the power supply portion.

However, right now I was more cerned with the possibility that capacitor might be faulty than w had overlooked it. Hastily seizing a capacitor, I tacked it across the su one and switched on. Up came the ture as bright and free from sh as one could wish, while a subse check showed that the strange beha of the IF valve had completely vani In short, the set was completely ba normal.

Naturally, I lost no time in ma the replacement permanent and re ing the set to the customer. T honest, I was glad to see the back

But what is the explanation fo the symptoms I had observed? In first place, it is not unusual for the ure of a filter network to play with a set's behaviour, producin kinds of apparently unrelated symp in different parts of the chassis. is invariably due to the filter fa causing unwanted coupling bet various sections via the common p supply, and the possible ramifica are almost unlimited.

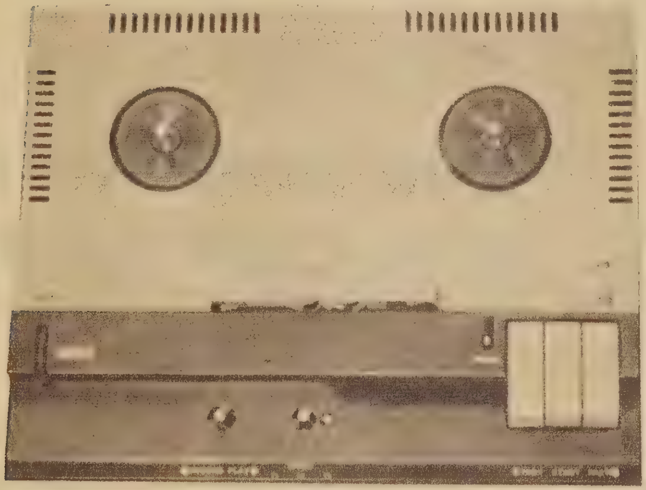
In this case, the shaded raster almost certainly due to 15KHz line quency information finding its wa the grid-cathode circuit of the pi tube, thereby modulating each line the same voltage gradient.

Just how this signal reached the

(Continued on Page 91.)

# *We proudly announce . . .*

# THE NEW
# "363" TAPE DECK



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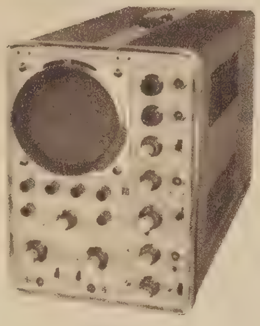

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**MODEL VP541A**

**Specifications:** D.C. to 15Mc, Dual trace. **Sensitivity:** 5mV/cm, both X, Y aves, completely variable, up to 50V/cm. **Sweep Range:** 0.2 usec/cm to 12.5 sec/cm, continuously variable. **Sweep Magnification:** 5, 10, 20, 50, 100. **Automatic triggering,** amplitude level selection with preset stability and single sweep. **Time Marker:** 4 ranges 0.1, 1, 10, 100 usec. **Calibration Voltage:** 12 square wave voltages from 25mV to 100V peak to peak. Bright Display: 8cm x 10cm.

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- The receivers "WV-716E" and "WV-705E" are specifically designed for ceiving only Video output.
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   One adjusting knob only located on the back of the camera. The easiest to operate of all the TV cameras now on the market—can be operated by anybody.
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**VIDEO OUTPUT TYPE RECEIVERS. WV-716E (16")**
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# NEWS ITEM

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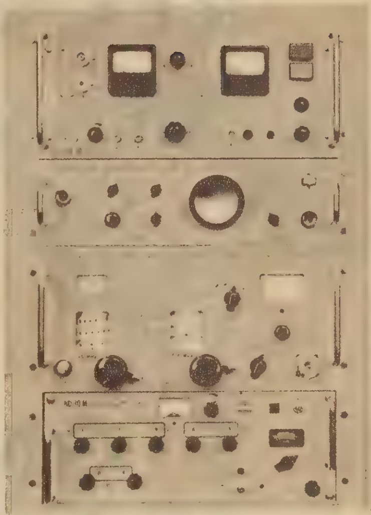

The unit comprises the following:—

**Frequency Synthesizer XUC (Rohde & Schwarz)**—produces crystal-accurate frequencies in 10 Mc and 1 Mc steps.

**Frequency Synthesizer ND 30 M (Schomandl)**—produces crystal-accurate frequencies in 10 c/s steps.

**Display Amplifier XMH (Rohde & Schwarz**—displays best frequencies below 5 Mc to locate microwave oscillator frequency before synchronisation.

**Syncriminator FDS 30 (Schomandl)**—enables phase-coherent synchronisation of klystron or carcinotron to a harmonic of the XUC unit.

The Syncriminator provides a control voltage to the frequency-controlling circuits of the klystron to hold this to the assigned frequency.

**Harmonic Mixer Unit FMDR (Schomandl)**—generates a 30 Mc beat frequency between the XUC and the klystron and feeds the Syncriminator.

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# SERVICEMAN — Continued

ure tube is not definite, but the most ikely possibilities seem to be that it ppeared on the HT line and from here to the plate of the video ampliier. Alternatively, or in addition, it could have reached the picture tube grid via the brightness control circuit. It s also significant that this shading remained after the video detector failed.

As to the silly behaviour of the last F stage, and the untimely failure of he video detector, these are less easy o explain. However, I feel quite sure n my own mind that the two are reated. More precisely, I feel that the F stage generated a spurious signal of sufficient amplitude to overload the diode, possibly causing it first to overheat and finally to fail completely.

This, of course, happened while I was working on the set. The main reason hat it hadn't happened previously would appear to be that the owners always switched the set off when it exhibited shading, ". . . in case it did some damage." On the other hand, yours truly, of necessity, had to keep the set running while chasing the fault.

The two most likely possibilities concerning the IF stage would seem to be a) that it was oscillating, or (b) that it was being fed with spurious line information via either the HT line, the AGC line, or both.

Anyway, whatever the cause, it seems pretty certain that a spurious signal of some sort was driving the grid silly, to he point where it was swinging positive and thereby drawing excessive screen current. Hence the low screen voltage.

Finally, how was it that an electroytic in a vital part of the power supply ike a voltage doubler could be faulty o this extent without significantly affectng the HT voltage?

The answer to this, I feel, is that it s largely a matter of degree. If the design of the set was such that there was very little tolerance to any loss of filtering at the line output frequency, but rather more tolerance at mains frequencies, then a small drop in capacitance or some increase in internal resistance — or both — could show as ack of isolation between stages before here was any significant drop in HT voltage.

The moral of the story, if there is one, must surely be that when a set displays a whole series of apparently unrelated symptoms, then it is a good time to check the filter networks.

And be sure to check them all!

Another job I had recently also emphasised the problem of correctly interpreting a symptom; in this case a relatively minor one which, however, indicated a condition which could have developed into a major fault.

In fact, the job was a double barrelled one, involving the fault about which the customer complained and one which I happened to detect by observing a quite minor symptom.

The owner's complaint was straightforward enough — sound but no picture. Arriving at the customer's home I pulled the set out from the wall, unscrewed the back, and switched on. As the set warmed up, the 6AU4 damper diode started to glow a bright red, and I switched off hastily. Fairly obviously, there was a short in the B-plus boost line or around the EHT transformer somewhere.

Being fairly familiar with the set, and having experienced similar symptoms before, I mentally nominated several possibilities; one of two .047uF filter capacitors across the boost line, one of three small value capacitors forming a network across the EHT transformer — and from which the AGC pulse was taken — an internal short in the valve itself, a short across the socket, or a breakdown to frame of the EHT transformer.

I also knew, from previous experience, that faults of this nature often show up only when the high voltage is applied, and checking with an ordinary ohmmeter is unlikely to prove very conclusive. A technique I have evolved, therefore, is to disconnect each suspect component in turn, until signs of the overload vanish.

Naturally, I tried a new 6AU4 first, but this achieved nothing. Then I commenced the process of elimination by disconnecting, one at a time, all the likely capacitors around this part of the circuit. I finished up with half the EHT system disconnected, but the short persisted.

Then I checked the 6AU4 socket but could find no sign of breakdown. Nevertheless, I took the opportunity to remove the unused contacts from the socket, since only four of the eight are used and some of them fall between active contacts having quite high voltages between them. As I expected, this achieved nothing in regard to the fault, but may provide some margin of safety in the future.

*"That Miss Winthrop's set must be on the blink again — you never look like that when old Mr Crockett calls you at this hour!"*
*(From "PF Reporter.")*

Finally I examined the yoke socket for signs of breakdown, but again drew a blank. And with so many blanks chalked up, it looked as though there was only one thing left, the EHT transformer itself.

To test this I first restored all the disconnected components, then unscrewed the transformer from its mounting and managed to juggle it so that it was supported, albeit somewhat precariously, in mid-air by its connecting leads. Then I switched on and tried again.

There was no doubt about it this time. The 6AU4 remained at normal temperature, and the picture came up on the screen. All that remained to be done was fit a new transformer. Fortunately I had a suitable replacement on hand and this was no more than a routine job.

Which brings us to the second half of the story. After the transformer was fitted and the set was running, I went over it checking for possible defects which the owner may have overlooked. The only thing I could find was a suggestion that the maximum brightness was not quite as bright as it should be. The effect was not marked and certainly not bad enough to have worried the customer. In fact it did little more than make me suspect that something was wrong.

Nevertheless, I decided to make a routine check of the brightness circuit. I started at the grid of the picture tube, and found the trouble almost straight away. The grid voltage was supplied from a divider network consisting of a 2.7M from the HT line in series with a 470K resistor to chassis, and I felt quite smug when I found that the 2.7M was several times its normal value.

It was rather disconcerting, therefore, when I replaced it and found that I now had more brightness than I knew what to do with — or could control. And not the least disturbing aspect of the situation was that I had now to find what was causing this seeming anomaly, or put the known faulty resistor back in the set; an intolerable suggestion.

I made another quick check of the components around the grid circuit, but this revealed nothing. Then fairly logically, I moved to the actual brightness control circuitry, which was in the cathode of the picture tube. This consisted of a 220K resistor from the HT line in series with a 200K pot to chassis, this latter being the actual brightness control.

Thus the brightness of the picture tube or, more correctly, the bias between cathode and grid, was the voltage difference between these two network tappings. As the 2.7M went high, the grid would become less positive and it would be necessary to reduce the positive voltage on the cathode, by means of the brightness control, in order to retain a given brightness level.

But why was the brightness control no longer working within its correct range? Believe it or not, but the 220K resistor in the brightness control network had also "gone high" and was several times its value. Since this was at the same (i.e. HT) end of its divider network as was the 2.7M in the grid network, its change of value had almost exactly offset that of 2.7M.

I say "almost," because there obviously was some disturbance of the system, otherwise my suspicions would not have been aroused. But the fact remains that two resistors were on the verge of complete failure, yet their combined defects had contrived to produce a barely noticeable symptom.

Had I not noticed the condition and checked it, either one could have failed within days of my service call; and I needn't dwell on the complications that sort of thing can cause.

So, moral number two: Even a minor symptom can mean a major fault, or at least one that needs to be checked.

The next story was related to me by a colleague. He is not a serviceman,

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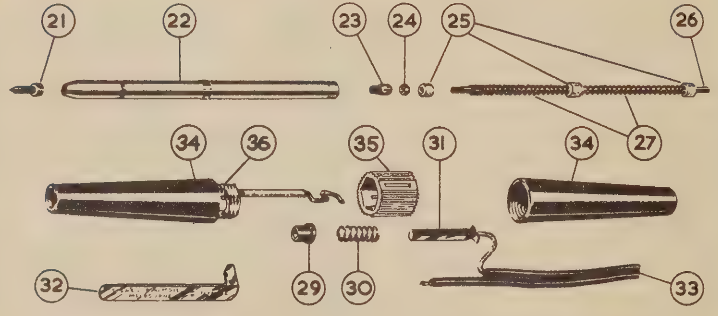

| | |
|---|---|
| 21 | Copper Tip |
| 22 | Barrel |
| 23 | Element |
| 24 | Bead Retaining Nut |
| 25 | Beads (3) |
| 26 | Push Rod |
| 27 | Push Rod Springs (2) |
| 29 | Insulating Bush |
| 30 | Switch Return Spring |
| 31 | Contact Lug |
| 32 | Switch Lever |
| 33 | Flex. Lead |
| 34 | Handle (2 halves) |
| 35 | Centre Piece |
| 36 | Brass Nut |

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but is engaged in other technical pursuits in the electronics industry and is well versed in such matters. Among other things, he had built for himself the 1959 TV receiver, described in this journal, and it is around this item that the story revolves.

He came home from work one evening to be greeted by his wife with the information that the TV set was giving trouble. According to the good lady, a picture had appeared briefly as the set warmed up, but had been very narrow and with a bright white line down the centre. The picture had then faded out completely. At the mention of a narrow picture and a white line, my friend had mentally registered trouble in the line output stage; probably a sick 6DQ6 line output valve.

So, right after the evening meal he fetched a spare 6DQ6 and a couple of other likely types from the workshop, and set about tracking down the trouble. On switching on, the symptoms were repeated almost exactly as described by his wife; a brief appearance of an underscanned picture, complete with white line, for a few seconds only, then nothing.

His first step was to replace the 6DQ6 and, when this did no good, he tried the 6AU4 damper diode and the 6CG7 horizontal oscillator. These were similarly ineffective.

It was now fairly obvious that it was not just a matter of a simple valve replacement, and that the chassis would have to come out of the cabinet, something which he had hoped to avoid. However, it was duly extracted and placed on its side on the kitchen table.

At this point my friend considered whether he should make another trip out to the workshop for his regular multimeter, or be content with a small Japanese pocket type he had on hand. Since it was a cold winter's night and he had no reason to believe that the small unit would not do the job it wasn't a hard decision to make.

He commenced with a voltage check around the 6DQ6. Plate voltage was normal and there was about 150 volts on the screen. This latter figure was a little low but, as my friend expressed it, "not sufficient to cause a complete failure of the stage." So, he chose to ignore it.

As far as he could determine, there was adequate drive being applied to the grid of the 6DQ6 which, together with reasonable plate and screen voltages, and a valve known to be good, should have produced at least some line output.

From this point on virtually every component in the line output system came under suspicion. The B plus booster capacitors, the capacitor network across the line output transformer, and even the yoke, were all considered and checked—and all proved fruitless.

So, at the end of an hour or so, my friend was no nearer the solution and, in fact, felt further away from it, since he was running out of things to check. About all that was left was the line output transformer and, as he expressed it, "I wasn't game to check that because, if it turned out to be all right, I wasn't quite sure what I would do next!"

In a more serious vein, he admitted that he didn't want to go to the trouble of changing the transformer until he had explored all other possibilities. However, it looked as though this time had come.

Then, remembering that the 6DQ6 screen voltage had been low, he picked up a couple of screwdrivers and used them to short out the screen resistor. Result: Immediate appearance of the picture on the screen, which vanished again when the short was removed.

Thoroughly suspicious by now, he measured the screen voltage again, and again registered 150 volts. Then, on an impulse, he reached down and felt the screen resistor. It was stone cold, even though it had been running for the best part of an hour and, at 2 watts rating, normally ran much too hot to touch.

What was going on?

A check with the ohmmeter produced even more puzzling results. The resistor was virtually open circuit and, while this explained why the stage wouldn't work, it only deepened the mystery of the 150 volts on the screen.

My friend continued to puzzle over this as he replaced the faulty resistor, fitted the chassis back in the cabinet, and cleaned up the mess. It was only after he had settled down to a well earned cup of tea and started to relax that a possible solution occurred to him.

He remembered that a friend of his had mentioned the rather strange behaviour of an identical meter when he had tried to measure the plate voltage of a gated AGC valve. Instead of a quite moderate voltage which he had expected, he was suddenly confronted with a ridiculous value well over 500 volts. And, without being able to find a precise explanation, he was forced to assume that the meter used some kind of strange rectifier system which caused it to read AC even on the DC scale. He solved the immediate problem by using a more conventional meter.

It now seemed fairly certain that my colleague had been trapped by this same meter characteristic, and further tests, which he made at my suggestion, confirmed that in the vicinity of a line output stage working normally, readings of the order of 500 volts were easily obtainable by simply waving the test prod in the vicinity of the line output valve or transformer.

It is true that while he was seeking the fault, the line output stage was not working, or at any rate, not working properly. But he remembered that it apparently had been active to some degree, since he was still able to observe a small spark, about 1/16in long, from the EHT lead.

Thus, there seems to be little doubt that what he originally mistook for DC screen voltage was, in fact, 15KHz line energy which happened to appear at the 6DQ6 screen.

Why do these meters behave in this manner?

This is something I have not been able to clarify so far. The inside of these meters has always been something of a mystery to me, and I do not even have access to a circuit which might help solve the mystery.

The only clue I have been able to obtain is a rumour from a fellow serviceman that someone he knows claims that one local TV set manufacturer — unnamed — has warned against using diode protected meters for certain measurements in the vicinity of the line output stage, since they can give inaccurate readings.

Apart from that, I am afraid that the actual reason must remain a mystery for the moment, although the warning may well save some reader from falling into a similar trap.

And, of course, the story is yet another example of how easy it is to be misled by apparently quite straightforward symptoms. ▬

# FORUM—continued from page 81

trol" in the March issue—both home builder projects.

Why weren't they featured before this?

As far as we are concerned, the answer is a very simple one: The articles coincided with commercial release of the devices in Australia, to individual consumers and at a price they would find attractive. We had many discussions with suppliers during the previous couple of years, to no avail.

Precisely the same situation now holds about FETs. Despite numerous enquiries, we have not been able to unearth a ready supply of FETs at an attractive price. H.C. says that he has been offered them at $1.00 a time; universities may have access to duty-free supplies denied to other users, but we have certainly not been offered them to date at anything remotely resembling this price.

And even when they are obtained, it does not follow that FETs will be an immediate and howling success. Some recent data sheets we saw specified that certain types must not even be packaged in ordinary plastic, for fear that static charges will destroy them. This kind of vulnerability does not sound promising for commercial, let alone homebuilder applications.

Has our staff the capacity to design around solid state devices? Among other things, the current series on Counting and Logic circuits should shed some light on this.

And what of people from industry and from universities being anxious to help by writing articles? It is certainly not hard to discover good intentions. But we find, along with learned journals, that it is much more difficult to secure actual articles, complete and well-written, suitable for publication.

Let us state here, for the record, that we are always interested to hear from potential authors and are happy to pay for articles used.

But, behind all this, is the fact that no one magazine can be all things to all readers. Each has to seek and develop a formula which will guarantee it enough regular readers to pay its way commercially; otherwise it will simply "go broke."

The formula and format we have adopted is finding wide acceptance in Australia at present, but we certainly don't delude ourselves into thinking that we completely meet everybody's need. Nor do we believe that it would be commercially practicable for a journal to do so—Australian or otherwise.

It is normal, in any field, for readers to have access to many journals and to build up their knowledge from such various sources. We have a job to do and we want to do it to the limit of our capacity, but we're not too good at miracles! ▬

# "MIGHTY MITE" MINIATURE MONITORS

## Built-in circuits detect malfunction

A revolutionary set of tiny test circuits in the form of micro-miniaturised chips may offer a way to eliminate virtually all mechanical and electrical gremlins from spacecraft and aircraft of the future. Developed by a Boeing engineer in Seattle, it represents a new attack on the problem of reliability.

The circuits — which in packaged form will be smaller than the head of a thumbtack — may later be employed in such down-to-earth tasks as tipping off an automobile driver when his brakes are unsafe or his fuel pump is failing. They may someday inform the householder when one of the valves in his television set needs replacing or when the amplifier in his stereo set has lost gain.

The circuit "chips" are tiny electronic test networks, but by no means are they merely conventional test equipment that has been shrunk. To reduce the size of such test equipment, without reducing its complexity, usually results in equipment that is still too heavy to be placed aboard anything but a very large aircraft.

Instead, Boeing started from scratch to seek an entirely new test concept and simple hardware to suit which, when microminiaturised, would produce vast savings both in test equipment weight and complexity. The circuit-chip networks are the result. They are a new generation of standardised, dynamic testing tools which can be built directly into a module or system to check its condition continuously.

Named MITE (for Microelectronic Integrated Test Equipment), each network is made up of approximately seven electronic "building block" chips and a specially designed conversion circuit which will translate the operation of a unit to be monitored into information the building blocks can read. In one arrangement, the circuit chips will monitor the output of one particular operating unit; in another arrangement, they will monitor another kind of unit. Once an arrangement has been perfected for a specific unit, the network then can be incorporated into all similar units at the time of manufacture.

When a module containing a MITE network goes to work in a spacecraft or aircraft, the conversion circuit continuously samples the unit's mechanical or electrical operation and converts it into a voltage reading. This voltage becomes a statement of the "health" of the unit during every moment of its working life. Should the voltage fluctuate beyond certain limits, bells will ring, red lights will flash, or — more often — a computer will be told that the unit is in trouble.

MITE has proved to be a successful alarm system in a demonstration model, but the microminiaturised test circuits are able to do more than wave a red flag.

**By feeding a unit's sample voltage into a decision-making device called a go/no-go detector, a system or module can be made to shut itself off instantly when an unusual change of voltage occurs, indicating a defect.**

This would put the finger on a faulty transistor in a spacecraft communic tions system, for example, during a fin assembly check. The unit would hav to function perfectly or it would n function at all. Equally, the devic could prevent the driver of a car fro being able to turn on his ignition unt his defective master brake cylinder w acknowledged and the MITE signal w released or overridden.

MITE also can have a switching cap bility. A detector could instantly shi control from a defective unit to a spa unit should a failure occur in an u manned spacecraft or during the oper tion of an aeroplane. In the course switching, MITE would notify a com puter or an operator of the failure an that a spare had been switched in t take the place of the failed unit.

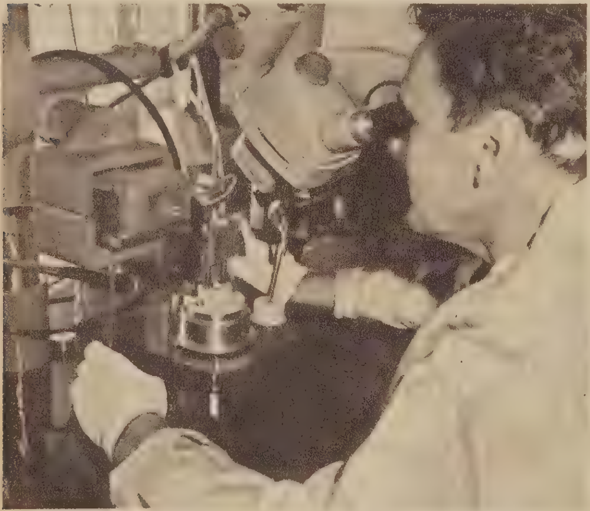
MITE could replace a large amou of ground equipment used for testing rocket or missile at Cape Kennedy an Minuteman launch sites.

**In a recent exercise, Boeing enginee found that a full set of MITE circui put aboard a test vehicle weighed le than the cables and signal-conditionin devices that were required to transm data to a building full of test equi ment. MITE would eliminate both th cables and much of the equipment, y accomplish the same amount of testing.**

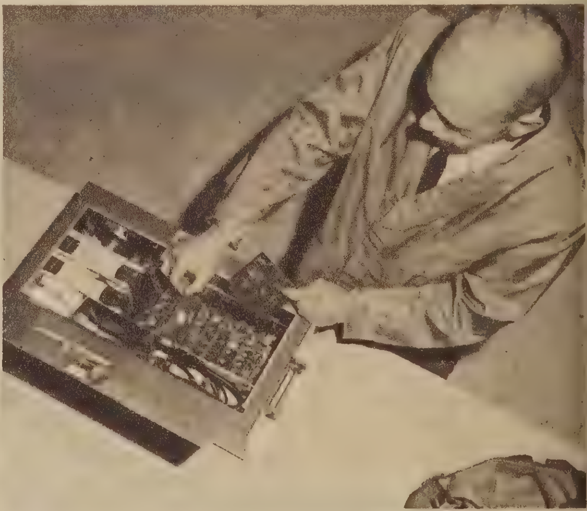
In terms of hardware, MITE is typ cally composed of a tunnel diode vol meter, a go/no-go detector, a choppe a converter (made up of a frequenc standard and a variable width gate), an a reference voltage generator.

A document is in the process of bein written describing the building and a plication of approximately 25 informa tion conversion circuits.

With these unique wafer-sized buildin blocks and conversion circuits, enginee can arrange MITE components in wh



*With the aid of a binocular microscope and micro-manipulators, tiny lead wires are bonded to the circuit "chip" by sonic welding, following transistor techniques.*



*Preliminary testing of the "Mite" concept can most easily be done with discrete components on ordinary circuit boards, the microminiature version being produced later.*

ever sequence they wish, to check everything from electronic flight control system pulses to structural stresses.

Suppose an engineer wishes MITE to stand guard over the gain of a critical amplifier while the load on the amplifier's power source is increased. The engineer puts three MITE building blocks together (a wide-band amplifier, a tunnel diode voltmeter and a go/no-go detector) and adds a conversion circuit to the amplifier circuit. He now has a test network with a high and a low cutoff point which constantly guards the amplifier's gain. If the gain strays above or below the limits, MITE will inform the designer of this situation.

MITE could run a continuous stress check on a vehicle in the same way. Stress would be examined by a stress transducer, converted into voltage by means of a transformation network, and high and low limits set. If the stress went beyond these limits, MITE would flash a warning.

To measure the absolute value of a test signal such as a temperature, different components and a different transformation network are used. In this application, the voltage across a resistance thermometer probe (mounted at a critical temperature spot in the system) is used to open the variable width gate portion of a converter.

*Harvey Balderston, the Boeing engineer who has developed the "Mite" concept over the past four years, compares a developmental circuit board with a "Mite" module.*

The voltage holds the gate portion of the converter open for a certain length of time (depending on its order) while a series of pulses pass through the gate and are counted. Should the temperature of the critical area shoot up, indicating a defect, the resistance thermometer develops more voltage, which in turn allows the gate to be held open longer, which in turn allows more pulses to pass. Either an operator or a computer then sounds a warning if too many pulses are being counted.

H. L. Balderston, the Boeing engineer responsible for developing the MITE concept over the past four years, explains that MITE only checks the functioning of each component or subsystem: how the engineer wishes to interpret the information is up to him. MITE could save thousands of dollars for airlines, says Balderston, if the func-

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7K
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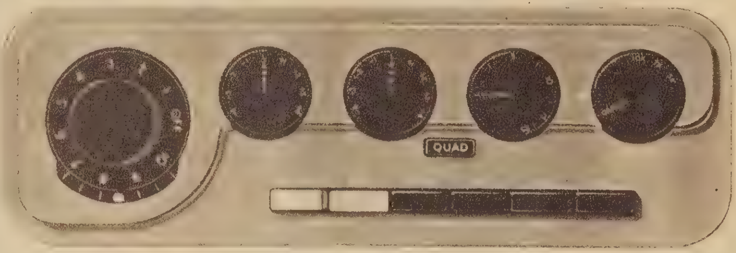

*For the closest approach to the original sound*

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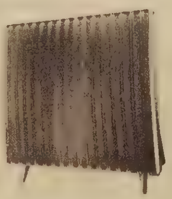

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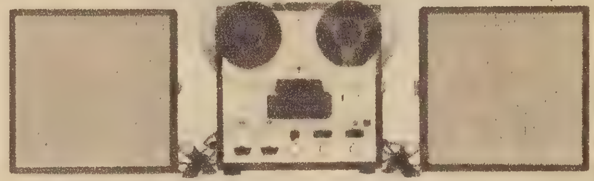

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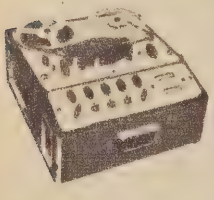

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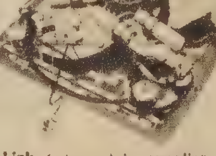

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*Photographic masks and images carry the patterns which are finally transferred to the "Mite" chips, but reduced to diminutive proportions.*

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Initial uses outside space research have been found for the batteries as power sources in remote locations such as navigation beacons in dangerous waters, submarine repeaters, and the like; in fact, in any situation where maintenance or refuelling present severe problems.

# A VOICE-OPERATED SWITCH FOR TAPE RECORDERS

GAIN
TAPE RECORDER 'VOX'
OVERRIDE
PRESS

### By Ian Pogson

This new transistor circuit for voice control of a tape recorder is compact in size and relatively simple. It does a similar job to the valve version, which we presented three years ago, and it should prove to be popular for both professional and amateur use

Just recently, we were confronted with ne need to develop a transistor version f a "VOX" unit to be used in associa-ion with a single sideband transmitter. Iaving duly developed a successful cir-uit, it occurred to us that it would be . good idea to adapt it for use with tape ecorders. The tape recorder "VOX" is eally a somewhat simplified version of he unit, as developed for transmitter use.

What does it do? Who would make ise of such a device? How is is done? Ve will answer these questions first, be-ore proceeding with the constructional letails.

When a tape recorder is fitted with me of these units, the recorder can perate unattended for long periods. This means that the tape will run only vhen a message or other material is oming through to be recorded. When he message or other signal stops, the ape will automatically stop running, intil another message comes through.

This method offers at least three ad-'antages over having to monitor mes-ages which come through only at irregu-ar intervals: (1) the presence of an perator is not required; (2) unnecessary unning and waste of tape is avoided; ind (3) on replay of the tape, there are io long gaps which have to be listened hrough.

The uses for such an arrangement ould be many and varied. An obvious me, which can be dismissed in a few vords, is a "gimmick" at parties and uch functions. An organisation operat-ng a two-way radio system may want to keep a record of its traffic over some given period. Again, it may be necessary or desirable to make a check of activity on a given channel. No doubt, many other uses will come to mind.

How all this is done can perhaps best be explained in easy stages. Firstly, a description of how the circuit operates will be given and then just how this can be put to practical use.

Reference to the circuit will show that four silicon transistors are used. The incoming signal, used to operate the system, is fed via a 100K gain control to the base of the first transistor. This transistor functions as an audio amplifier.

The output of the first transistor is rectified by the first germanium diode and the DC voltage obtained is "gated" through the second germanium diode. In fact, the two diodes combine to form a voltage doubler arrangement. The DC which is passed through the gating diode charges the 50uF capacitor.

The following three transistors all function as switches. Without any signal, the second transistor is cut off, the third transistor is "bottomed," with the fourth transistor also cut off.

Returning now to the second transistor. Although it is normally cut off, it is biased in the forward direction by the 1M and 39K voltage divider. The bias, however, is adjusted such that it is just below the point of conduction. This is done in order to speed up the initial attack time. In fact, the 50uF capacitor is charged up to this voltage and when a signal appears, it is only necessary to increase this voltage by a small amount, to drive the transistor into conduction.

Before a signal is applied, because the second transistor is not conducting sufficient forward bias is applied through the common 68K resistor, to the base of the third transistor, to keep it bottomed. The collector of this transistor is coupled to the base of the fourth transistor, via a 4.3 volt zener diode.

The presence of a signal results in a reduction in current flowing through the third transistor and the collector voltage rises. When this reaches the voltage of the zener diode, it conducts and so the fourth transistor is forward biased into bottoming. The zener diode could be dispensed with, but in doing so, the transisition between cut-off and bottoming can be indeterminate, which causes the relay to chatter.

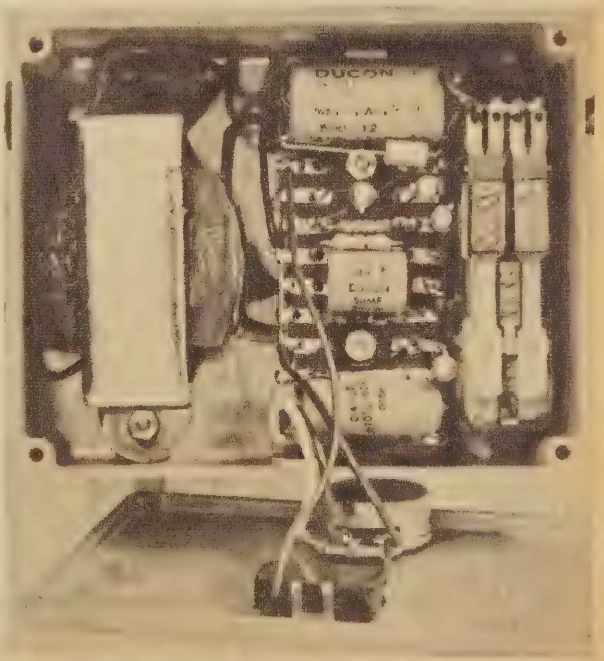
The relay winding is connected in the collector circuit of the fourth transistor. As this transistor is normally cut off, no current will flow through the winding. With a signal applied, the relay is operated. A silicon diode is placed across the relay winding so that it will absorb the back EMF generated in the winding, when the collector current is suddenly cut off. Without the protecting silicon diode, damage may be caused to the fourth transistor.

To make all this clearer, let us consider the full sequence of operations. An audio signal is amplified by the first transistor. The signal is rectified and the 50uF capacitor is charged sufficiently to cause the second transistor to conduct.

The collector current through the 68K resistor, causes the voltage at the collector to fall. This voltage drop reduces the forward bias on the third transistor and so its collector current is subseantially reduced. In turn, the reduced

*The picture above gives some idea of the compactness of the unit. The "override" switch is similar to those used on small reading lamps. Other types may be substituted, if desired.*

*The interior view (right) indicates that there is little room to spare, but if our layout is adopted, no difficulty should be experienced fitting in all the componets. When this picture was taken, two sets of "make" contacts were wired in parallel, on the relay.*



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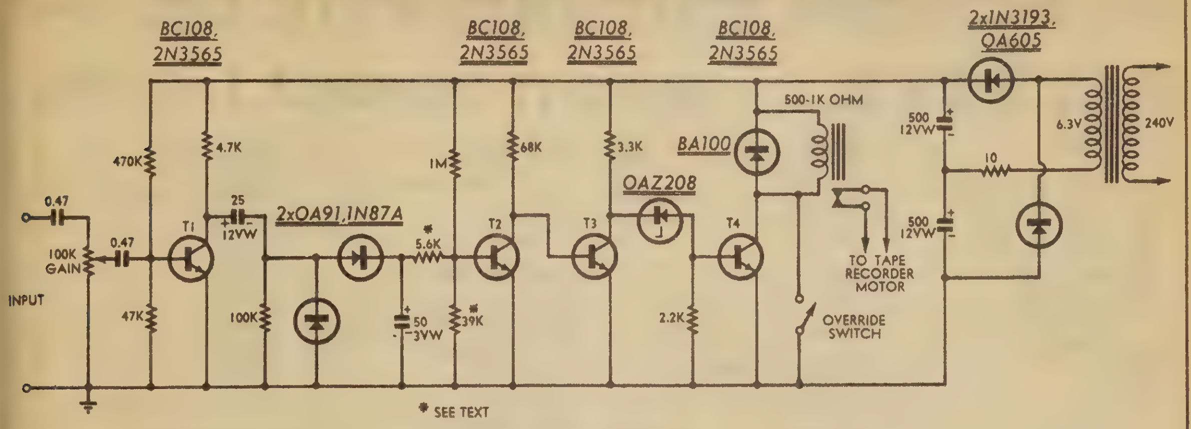

**TRANSISTORISED "VOX"**

*A full description of the circuit operation is given in the text. We used a 1000 ohm relay winding, but anything from 500 to 1000 ohms should be satisfactory. Only a set of "break" contacts is shown on the relay, but a set of "make" contacts may be included, which makes the unit more versatile, capable of meeting all requirements.*

urrent through the 3.3K resistor causes he collector voltage to rise.

Having reached a high enough value, he zener diode suddenly conducts. A oltage divider is formed by the 3.3K esistor, the OAZ208 zener diode and he 2.2K resistor, in series. The volage at the junction of the zener diode nd the 2.2K resistor is sufficient to ottom the fourth transistor. The heavy urrent flowing through the collector ciruit of the fourth transistor, operates he relay. While ever there is a signal oming into the system, all circuits emain in the condition just described.

Consider now, what happens when the ncoming signal is stopped. The 50uF apacitor will discharge through the 5.6K esistor and the base circuit of the econd transistor. When this voltage falls elow a certain value, the transistor will ut off. Conditions immediately restore o normal again. The third transistor is ottomed, the zener diode stops conducting, the fourth transistor cuts off and the elay opens. The overall operation is one f very fast "attack" and slow release ime constants.

The necessity for a fast attack time onstant is obvious, in that it is desirable o get the first word of a signal without lipping of the first syllable. In order to chieve this fast attack, in addition to the eed for some initial forward bias on he second transistor, it is also necessary o provide a fairly low source impedance or the detector. Where a lower value f coupling capacitance would normally uffice, the 25uF electrolytic is a "must."

The release time is largely determined y the 50uF capacitor and the 5.6K resistor. This combination gives a release ime of approximately two seconds, hich should be about right for most urposes. This time may be increased r decreased by making the 5.6K resistor larger or smaller in value, respectively. Alternatively, this time constant nay be made variable, by wiring a otentiometer in circuit, in place of the .6K resistor.

The 39K resistor may need some adjustment and more will be said about his later on.

The zener diode as used, with a nominal 4.3 volts has been found to be most atisfactory. However, we have tried ener diodes rated up to a nominal 7.5 olts, and the results were satisfactory ut perhaps not as positive as the lower oltage rating.

An over-ride switch is connected from he collector of the fourth transistor and earth. By closing this switch, the relay can be operated without the need for a signal to perform this function.

The relay which we used was made by Pye Pty. Ltd. It is a type S2400, with a 1000-ohm winding and contacts rated at 5 amps at 240 volts AC. Two pairs of contacts are provided, one pair is normally open and the other pair is normally closed. More will be said about these contacts later on. If you happen to have a 600 type relay on hand, with a coil resistance of 500 to 1000 ohms, this could be used, provided it has suitable contacts. It should not have more sets of contacts than necessary, as this could slow down its operation and so cause clipping.

The power supply is a simple voltage-doubler arrangement, providing a supply voltage of between about 16 and 18 volts. The transformer is a small 6.3V heater type. The one we used had two windings rated each at 0.5 amp, which we connected in parallel.

To make use of the VOX unit in association with your tape recorder, it is necessary to make certain connections between the two pieces of equipment. Some of the audio signal must be picked off the recorder and then fed into the VOX input. Perhaps this can be most conveniently done by connecting across the voice coil of the speaker. When the voice coil is connected to earth on one side, this should be followed through on the earth side of the VOX input.

A better method of intercepting the signal, is that as commended in our previous article in August, 1963. Most tape recorders have two input jacks, one for microphone and one for pickup or radio. Figure 1 shows a fairly typical input circuit.

It is, in fact, desirable that the signal input for the VOX should be intercepted at the tape recorder amplifier before the gain control. If this is not done, as in the case mentioned earlier, by connecting across the speaker voice coil, adjustment of the VOX gain control may become rather tricky. However, the voice coil method may be used if it happens to be more convenient.

In figure 1, the VOX input is shown as being taken from the pickup terminal. When connected this way, the VOX will receive enough audio signal to operate from either microphone or pickup/radio input and will be independent of the volume control setting. Unless an unusually high output microphone is being used, the VOX will not operate directly from the microphone input.

In the circuit diagram, the leads from the relay contacts are simply marked "to tape recorder motor." If your recorder is of the single motor type, it is only necessary to locate the 240 volt leads to the motor and wire the relay contacts in

## PARTS LIST

*1 Die-cast box 4 5/8in x 3 5/8in x 2 3/16in.*
*1 Power transformer 6.3V.*
*1 Relay (see text).*
*1 Switch press-on, press-off.*
*4 Transistors BC108, 2N3565.*
*2 Germanium diodes OA91, 1N87A.*
*1 Silicon diode BA100.*
*1 Zener diode OAZ208.*
*2 Power diodes 1N3193, OA605.*
*1 100K curve "A" potentiometer.*

### CAPACITORS

*2 .047uF low voltage plastic.*
*1 25uF 12VW electrolytic.*
*1 50uF 3VW electrolytic.*
*2 500uF 12VW electrolytics.*

### RESISTORS

*(½ watt 10 per cent tolerance)*

| | | | |
|---|---|---|---|
| *1* | *10 ohms.* | *1* | *39K (see text).* |
| *1* | *2.2K.* | *1* | *47K.* |
| *1* | *3.3K.* | *1* | *68K.* |
| *1* | *4.7K.* | *1* | *100K.* |
| *1* | *5.6K.* | *1* | *470K.* |

### SUNDRIES

*1 Miniature tag board strip, with 13 pairs of tags.*
*1 3-tag strip.*
*1 Knob.*
*2 Grommets.*
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- S/W A.C. 1
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- D.C.-D.C. 60W
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- Diode Noise Generator
- G.D.O.
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- Transistor Signal Tracer
- Transistor Pattern Generator
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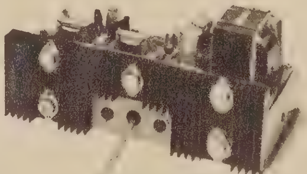
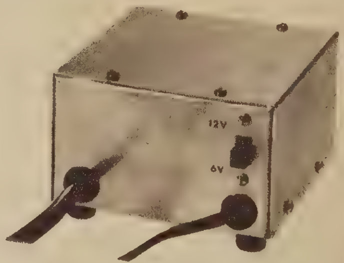


**Playmaster 113**

**1966 VTVM**



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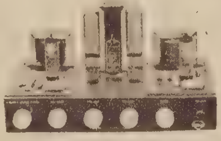

**Mullard Stereo 3.3**

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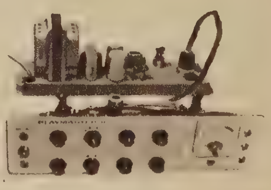

**Playmaster 110 Tape Amp.**

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series with one of the leads.

If the recorder has three separate motors, one for each of the spools and one for the capstan, it is important that the relay should be placed in series with a 240-volt lead which is common to all three motors.

It is no use interrupting the supply to the drive motor alone, as this might lead to overheating and possible burn-out of the spool motors. For proper operation, the supply voltage to all three motors must be interrupted simultaneously by the single set of contacts on the relay.

Placing the relay contacts in series with either one of the main 240 volt leads to the recorder "deck" will meet the requirements quite well. On NO account should the 240 volt wiring to the function switches (fast forward, fast reverse, playback, record, etc.) be disturbed, since this could lead to interruption of the supply to only one motor.

In some cases, it may be necessary to wire a capacitor between one side of the relay contacts and earth, to suppress the small arc caused when the relay opens the circuit to the motor. It may even have to be as high as 0.1uF in value and this may best be found by experiment. If this capacitor is found to be necessary, care should be taken to provide a good earth connection to the equipment. If this is not done, the operator could receive a healthy "bite" from the microphone, or in fact any portion which is connected to the chassis.

Without this suppressor, the electrical noise of the motor switching off may rip the VOX back into operation again and the unit would go on cycling in this manner ad infinitum.

So far, we have concerned ourelves with the need to interrupt the 240 volt supply to the motor(s). One battery-operated portable recorder which we used for our checks was quite a different proposition. This unit was fitted with n external foot-operated switch which n turn, operated a relay inside the ecorder. With this facility, it appeared nly to be necessary to connect our VOX relay contacts across the footwitch.

This indeed proved to be the case. lowever, instead of a pair of "make" ontacts, a pair of "break" contacts were eeded. In other words, the relay conacts in the VOX unit had to open in rder to start the motor. In our VOX nit, we have provided a pair of make nd a pair of break contacts, which lows us to deal with either situation.

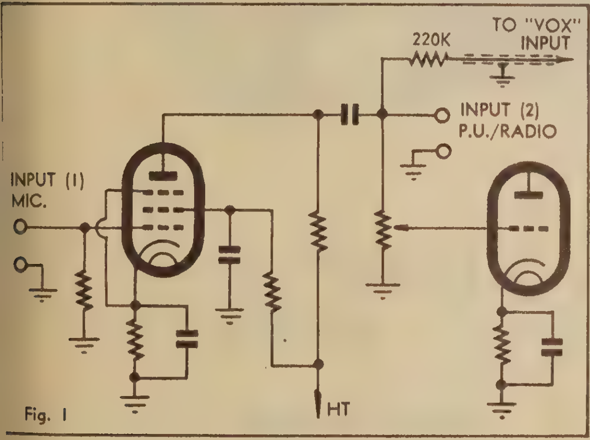
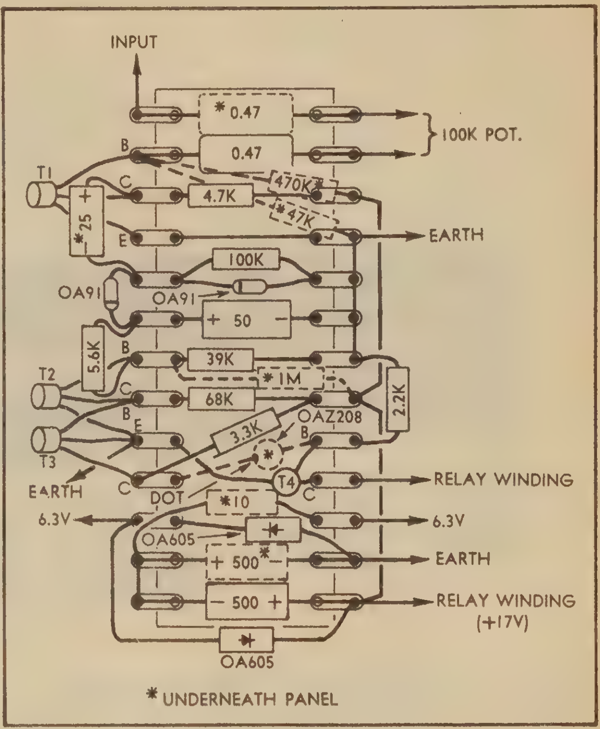


Fig. 1

*This supplementary circuit shows a recommended method of connecting the VOX into the circuitry of the average tape recorder.*

As it would not always be convenient to have the tape recorder operated by the VOX control, it is necessary to provide some means of switching to normal manual control. This is achieved by the "override" switch. We used a "press-on," "press-off" switch and as mentioned previously, it is wired from the collector of the fourth transistor to earth. To change over to manual control, it is only necessary to press the switch button. Pressing the button again, reverts to VOX control. If preferred, a toggle switch may be substituted for the type which we used.



*We have taken the trouble to give a wiring diagram of the tag board and by following it closely, the parts will fit into place without difficulty. Note carefully, those items placed underneath the board. These are indicated by asterisks.*

Having connected the VOX control unit with the tape recorder, it is only necessary to follow a few simple steps to set up the system for use. Proceed as follows:

1. Make sure that the "override" switch is in the off position and turn the VOX gain control right off.

2. Set the recorder function switch to the "record" position and set the "record volume" control for a normal indication on the "record level" meter or indicator. (Note that, at this stage, the tape will be stationary because the 240 volt line to the tape motor(s) is open-circuited by the VOX relay.)

3. Slowly advance the VOX gain control unit, with the minimum input signal you could expect to receive, the VOX relay trips into operation and starts the recorder motor(s) operating. (It may be found desirable to advance the gain control a little further still, to ensure the fastest possible attack time.)

As the VOX control would be used mainly for speech, it would be an advantage to run the recorder at its lowest tape speed. By doing this, the tape will run up to speed in the minimum time. There will also be a minimum of tape spillage when the VOX switches the motor(s) off. It also follows naturally that the greatest amount of information can be recorded on a given length of tape.

From a constructional point of view, the unit is quite simple and it does not call for a great deal of explanation. We built ours into a die-cast metal box, which measures 4-5/8in x 3-5/8in x 2-3/16in. For those who wish to use this box, it is made by Eddystone and the type No. is 650.

Layout is not critical but we strongly recommend that you follow ours if you build it into the Eddystone box, as there is not much surplus space. The photograph shows the general layout and the wiring diagram gives clear details of the component wiring on the tag board.

One thing which cannot be seen from the illustrations, is the method of mounting the relay. We fashioned a small L-shaped bracket from 16 gauge aluminium. If aluminium is used, do not attempt to use a lighter gauge. Steel or brass would be suitable and the gauge may be lighter but it should be sufficient to support the weight of the relay.

Three holes are drilled in one leg of the bracket so as to take the relay and the other leg has two holes whereby the complete assembly is mounted on the base of the box.

If you decide to build the unit, taking some other physical form, there is one important point to watch: Remember that the 240 volt mains supply may be involved and suitable precautions should be taken.

In some cases, it may be possible to fit or build the unit into a case of the

**(Continued on page 174)**

# Public Address Amplifiers

## Models PA 35 and PA 65

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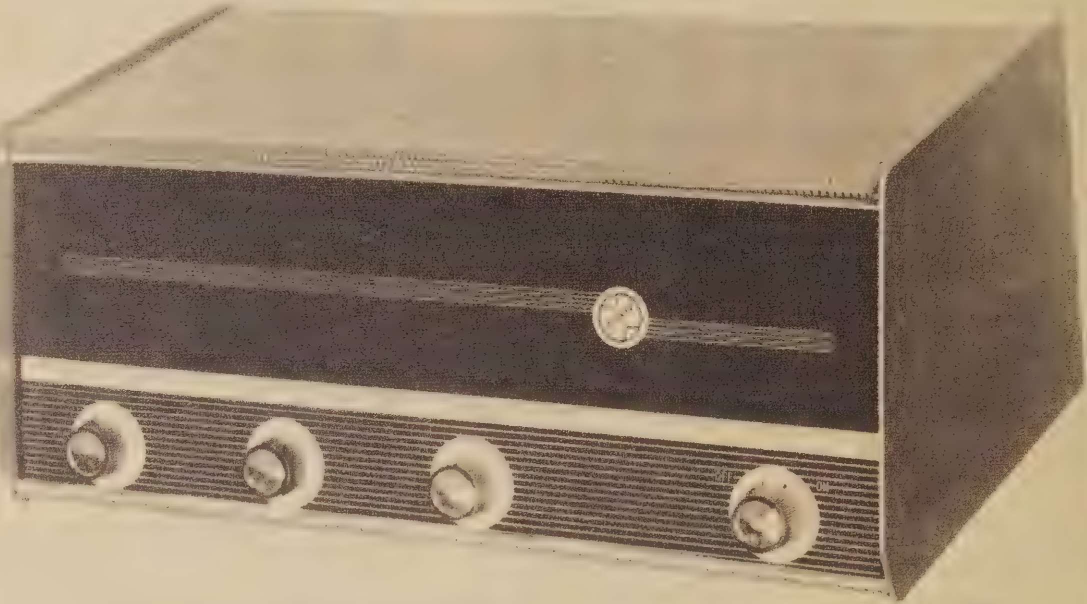

### TECHNICAL SPECIFICATIONS

| | PA 35 | PA 65 |
|---|---|---|
| Nominal power | 35 watts | 65 watts |
| Peak power | 40 watts | 70 watts |
| Microphone sens. | 3MV (100K ohms) | As PA 35 |
| Pickup sens | 125MV (1 megohm) | " |
| Tone control | Minus 20DB at 10KC | " |
| Response | 30-17,000 CPS + 3DB | " |
| Noise | Minus 60 DB | " |
| Inputs | 1 microphone/ 1 pickup | " |
| Provision for | 50 ohm Input | " |
| Output impedance | 100V Line (330 ohms) | " |
| Regulation | 3 DB | " |
| Valves | Two 12Ax7<br>Two 6DQ6B | " |
| Rectifier | 5 x IN3194 Silicon Diodes | "<br>As PA35 |
| Fuse | 2 amp. | 2 amp. |
| Dimensions | 16" x 9½" x 6½" | As PA 35 |
| Gross Weight | 21 lb. | 21 lb. |

**PA 35 $117.25**
**£58/12/6**

**PA 65 $138.60**
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# HOLOGRAPHY — 3D BREAKTHROUGH

(Continued from Page 21.)

much brighter laser having sufficient coherence.

At the present time it is impossible to transmit such three-dimensional pictures for television because of the extraordinarily wide bandwith required. Perhaps a new bandwith compression method which Professor Gabor is said to be advancing for television recording, or electron beam recording techniques being explored by Ampex, I.T.T., and RCA in U.S.A., may solve this problem, one of many.

During the past two years many other avenues have been opened to holography. Only last year T. P. Vogel and A. K. Rigler of the Westinghouse Laboratories in U.S.A. demonstrated high quality three-dimensional images by means of reflection holograms, that is by reflecting the viewing light beam from the aluminised emulsion of an ordinary hologram. This makes it possible to duplicate holograms in quantity by "replication" technique (see "Diffraction Grating," "ELECTRONICS Australia," July, 1966) and opens a new era in book and magazine illustration with real three-dimensional pictures.

Until recently it was believed that holograms can be made in coherent light only. Three years ago Young and Mertz first realised, in theory, that a hologram can be made in any non-coherent radiation if it is only monochromatic. Otherwise, it is not necessary that light wavelets from all object points must be mutually coherent. It is well known that light wavefronts from one object point, when split and superimposed on each other, produce stationary interference pattern in the form of a tiny Fresnel Zone Plate. Hence, it is necessary to split wavefronts from each object point and superimpose on each other on the film.

There are many methods of such wave front splitting; several of these are outlined by A. W. Lohmann in reference 12.

In the reconstruction process, the tiny FZPs in the hologram produce the image of the object when illuminated in the laser light, but all non-coherent effects must be removed as noise by any of the known noise-elimination techniques.

An important new development was announced recently—neither coherent nor monochromatic light is required for hologram viewing. The making of such holograms require different techniques altogether. In principle, a reference beam of coherent light illuminates the hologram emulsion from the back, while the reflected wavefronts from the object are ncident on the front of the emulsion. Layers of precipitated silver grains are produced inside the emulsion where the standing waves produced by the interference had their maxima. If white light s shone on to such a hologram, it absorbs all colours except the one which made it. The three-dimensional image hen appears in this colour.

Another amazing but logical property of a hologram is that one can record at east 10 different holograms on one film — without any interfering with each ther in any way. A different angle, heta, between the reflected wavefront W and the reference wavefront R (Fig. ) is used for recording each object or scene. This is achieved, simply, by changing the position of the hologram for each exposure. In viewing, each picture in the multi-hologram becomes visible, only, at a particular incidence of the illuminating laser beam. More recently, Professor Leith of the University of Michigan demonstrated three-dimensional movie scenes simply by rotating a multi-scene hologram in a laser beam. Consequently it is possible to make "volume" holograms which transmit three primary colours, such as red, green and blue, at the same time.

Two-colour holograms have been successfully made using red and blue light from He-Ne and Argon lasers respectively. A colour-producing hologram itself is always in black-and-white. The colour discimination is effected by the difference in the spacing of the silver grain layers in the hologram. Such a hologram would require ordinary white light for viewing and displays on the other side a three-dimensional image in full colour.

Today, the state of art in holography recalls the early days of the radio and transistor era. The interest is great and technical improvements come in rapid succession. It appears that holography will offer a remarkable service to our civilisation in the near future when it will become a part of our everyday life — in science, education and entertainment.

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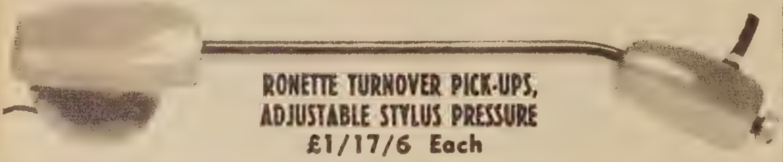

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| 6N8 ... | 12/6 | UU9 .... | 10/ |

# A READER BUILT IT!

*Circuits and devices which we have not actually tested in our laboratory but published for the general interest of beginners and experimenters.*

## A two-transistor, reflex broadcast receiver

A two transistor reflex broadcast receiver, submitted by J. L. H. Tee, 1 Darling St., Kensington, N.S.W., is the subject of our "Reader Built It" feature this month. The article which follows is substantially in Mr. Tee's own words.

This circuit, as far as I can ascertain, includes certain features that are original. I have chosen to call it the "Transporta Two," as it is truly transportable, giving a most creditable performance at the bedside or on the beach. Its volume is more than adequate and nter-station interference is at a very low evel in the background. At my location, stations at the top end of the band are received rather weakly.

The circuit was designed around a wo-stage RC coupled amplifier possessing high gain and wide band with. Use of alloy diffused AF115N transistors, ogether with low loads, assures sufficient bandwidth to amplify all frequencies within the broadcast band to the same degree as at AF. Those wishing to use ransistors other than these must be prepared to experiment.

T1 is operated at approximately 1.5mA, which might seem to be unduly high at such a low power level, but is necessary in order to obtain sufficient Beta. T2 draws approximately 0.3mA and little improvement is to be gained by perating it at a higher current level. The total drain should not amount to more than approximately 0.9mA, so battery life should be quite long.

**Readers are invited to submit ideas for publication on this page. Any items used will be paid for at standard rates. Rough sketches and circuits are sufficient, as they will be redrawn by our own draughtsman.**

Bias stability is not the best, but good nough for such an application, unless of ourse, the set is to be operated in a aundry or some such place. Those who ecide to operate the receiver from a ource higher than the specified 3V, would be well advised to re-design the ias network along more conservative nes.

A few words regarding the 0.luF inter-age coupling capacitors: Crystal earpieces are notoriously inefficient at low requencies, but those that are sufficiently powerful enough to be heard produce n annoying buzz. If it is considered hat the final result is a bit "tiny" these ay be increased to 0.22uF.

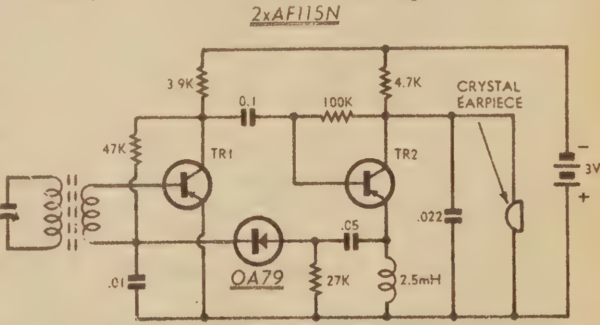
At AF, the circuit operates as a two-age, RC coupled, common emitter am-ifier, with its input derived from the demodulator, and its output taken across the 4.7K resistor. At RF, the input transistor is connected as a common emitter, and the output transistor as common collector, the collector being effectively maintained at chassis potential by the .002uF capacitor.

The load for T2 is provided by the 2.5mH choke, the demodulating network, consisting of the 0A79 diode, .05 and .01uF capacitors, the 27K resistor, and the input impedance of T1. The 27K and 47K resistors forward bias the diode slightly, thus giving a higher detection efficiency, the result being equivalent to that obtained from a voltage doubler.

The value of the coupling capacitor is chosen to give a small degree of negative feedback at high frequencies to improve the stability. By directly coupling the diode to the base of T2, one coupling component is saved and a small amount of AGC is gained.

Whilst higher gain could be achieved at RF by operating T2 in common emitter, the circuit would then be potentially unstable due to the feeding back, in phase, of high frequency components through the demodulating network to the base of T1. By operating T2 in common collector, any high frequency component is fed back to T1 out of phase, and the problem of instability is eliminated. Also, with T2 operated in this configuration, there is good isolation between the input and output at RF. Admittedly, its gain is then restricted to approximately 10db, but, overall, sufficient gain is available.

No volume control is provided as sufficient control over this can be exercised due to the directional characteristic of the rod aerial, and the limited AGC present. The selectivity is adequate without resort to regeneration, but sensitivity is poor and cannot be compared to the one transistor reflex receiver, described in "Radio, Television and Hobbies," June, 1963, in this respect.



The aerial coil is wound on a piece of ferrite rod of approximately 2½in in length. The number of turns on the primary is dependent on the tuning capacitor used, with 10 turns on the secondary a good compromise between sensitivity and selectivity. Those living in a good reception area might be able to reduce this number of turns, but do not expect any spectacular increase in selectivity by doing so.

Finally, just how small the set may be built is up to individual ingenuity. ■

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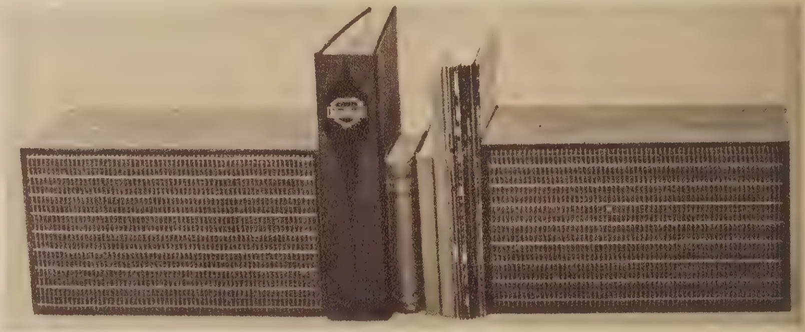

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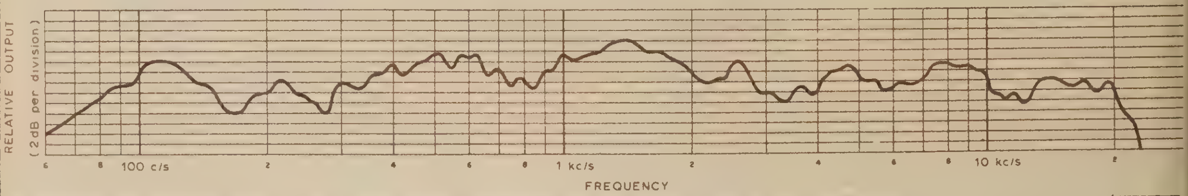

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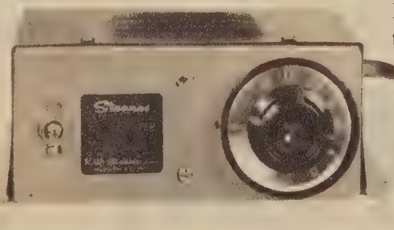

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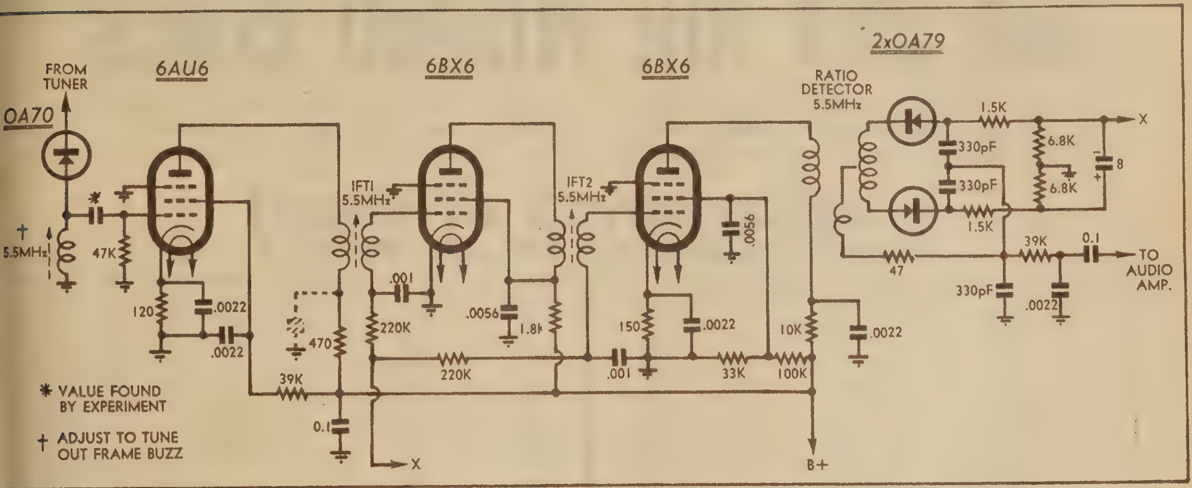
# A READER BUILT IT — Continued

## *Novel suggestion for a sound-only TV tuner*



**Readers who have been discussing the problem of a sound only TV tuner, should be most interested in a letter to hand from Mr. B.A. Sallur of 72 Pitt St., Bentley, W.A. He claims to have successfully exploited an approach which most people have probably passed over as impractical.**

Mr Sallur explains his approach in ː following paragraphs:

Dear Sir,

With reference to your article ı "Why Not a Sound TV Tuner" pril, 1966) I cannot contain myself y longer. Four years ago I constructed :h a device — a TV sound tuner that :ed into a mantel radio cabinet.

Quite simply, I was asked by a blind oman whether I would build her a all receiver to tune in the TV stations d which could be carried from room room; also that it have a minimum controls. I smiled weakly and said ıt I would try for her!

Knowing only a little about TV, I approached several TV mechanics but the est thing they said was that I was sting my time. This made me all more determined to work things out myself, and this is how my reasoning went:

The output from an ordinary channel er contains both picture and sound nals. If these signals were mixed nediately, tuned amplifiers resonating :he difference frequency and followed a ratio detector would surely give me nething.

t surely did! There was no drift or ability. All TV stations could be :ived extremely well with an indoor :nna. The controls were simply ınnel, Volume, Tone. (I have had rely on memory for precise details the circuit.)

efore handing over the tuner to the ', I took it around to a friend who n the recording business and he re-ded some very good quality music n it — the sort the stations transmit ore commencing their programs.

he valves I used happened to be e on hand but I dare say that others could be used equally well. Naturally, some experimenting was necessary, particularly the bit of circuitry between the tuner and the first IF valve.

So there it is. I would be most interested to read your comments on this circuit and — by the way — congratulations on producing such an extremely useful and interesting magazine. — B. A. Sallur.

EDITOR'S COMMENT: The "ingredients" for the 5.5MHz resultant certainly exist at the output of the tuner but the amplitude of the 5.5MHz signal at the output of the diode must be very small indeed and, of course, much smaller than it would be from the normal video detector or amplifier. This is confirmed by the fact that Mr Sallur specifies a 3-stage amplifier at 5.5MHz, whereas the usual TV set gets by with one or, at most, two such stages.

The use of a 3-stage amplifier prompts one to speculate why Mr Sallur did not run into trouble with instability, particularly as the valves operate at normal initial gain and only the IF transformers are not heavily shunted.

There is also the question of selectivity ahead of the ratio detector transformer and the potential restriction it could impose on the natural S-curve of the ratio detector.

And what of frame buzz, which presents such a potential problem to those who want to reproduce TV sound through high fidelity equipment. In a mantel-style receiver, this could have been passed over but Mr Sallur specifically mentions use of the tuner with recording equipment.

However, the plain fact is that he obtained good results from an approach that most will have passed over as impractical. It's over now to other readers who may like to experiment along these lines. ■

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| 2" | 406T | ½" | 6 | 70c |
| 2" | 408T | ½" | 8 | 70c |
| 2" | 504T | ⅝" | 4 | 80c |
| 2" | 506T | ⅝" | 6 | 80c |
| 2" | 508T | ⅝" | 8 | 80c |
| 2" | 604T | ¾" | 4 | 90c |
| 2" | 606T | ¾" | 6 | 90c |
| 2" | 608T | ¾" | 8 | 90c |
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# KNOW YOUR GRAMOPHONE*

## A plain man's guide to records and producers

By JOHN BORWICK, B.Sc.

## PART ONE — EVOLUTION OF THE DISC

Playing the gramophone will always e easier than playing the saxophone. nd I do not intend in this series of rticles to make difficulties where none xist. All the same, as readers' letters emonstrate, the choice, setting up, ad- sting and operating of modern gramo- hone equipment can present problems.

My aim is therefore to outline, with bare minimum of technical jargon, the asic information you need to get maxi- ium musical enjoyment from a modern ecord player, radiogram or hi-fi set.

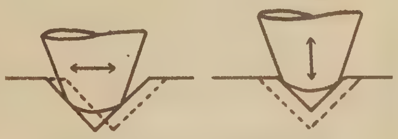

*Figure 2: Comparing lateral and hill-and-dale recording. In lateral recording (left) the stylus moves to left and right in a groove of constant depth; in hill-and-dale recording (right) the stylus moves up and down.*

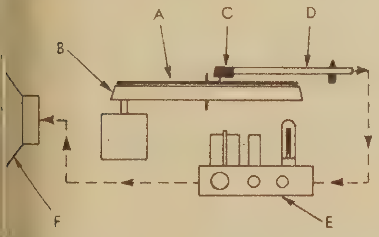

*Figure 1: Charting the course. This series of articles will deal in turn with A, the disc itself; B, the turntable; C, the pickup cartridge; D, the pickup arm; E, the amplifier; F, the loudspeaker and finally the listening-room.*

**Charting the Course:** The ground we all cover is as follows:—this month we all see how the disc evolved, first as competitor and then as vanquisher of e cylinder.

Next month we shall study the re- aining parameters of the disc itself and ow gramophone records are made -from the studio to the final pressing.

Then in turn we shall deal with each k in the reproducing chain (see figure —turntables, cartridges, pickup arms, nplifiers, loudspeakers and listening oms.

Besides describing in reasonably non- chnical language the workings of these mponent parts, I shall try to answer e questions that crop up in choosing, tting up, operating and caring for em.

**Evolution of the Gramophone:** All und is vibration. The sources of sound rate — violin strings, vocal chords, mbals, loudspeaker diaphragms; the in the path of a sound wave vibrates; eardrum vibrates in sympathy with air vibrations and so generates the sensation of sound to the brain of the listener.

If any method can be devised to record sound vibrations, then we have a means of storing sound.

If any method can be devised to reproduce the recording at a later date, then we can re-create the sound vibrations, the sound waves and the sensations of sound as they would have appeared to a listener who was present at the original "performance."

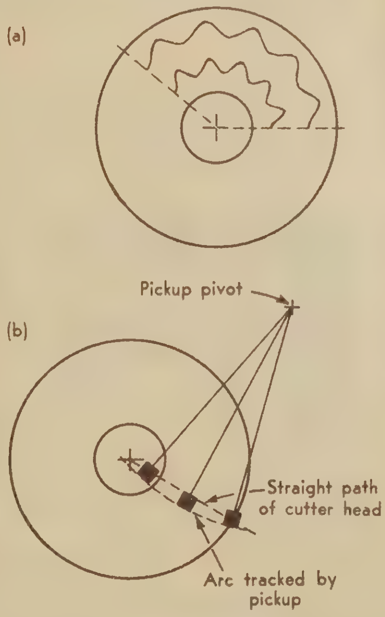

*Figure 3: Distortions inherent in disc reproduction with a pivoted pickup arm. (a) The recorded waveform becomes cramped toward the centre of the disc due to the progressive fall in linear recording speed. (b) The pickup head follows a curved path across the disc and, therefore, unlike the cutter head, it does not remain strictly at right-angles to the groove.*

In fact, sound recording did come first. Around 1857, the French physicist Leon Scott built the "Phonautograph" which consisted of an inverted megaphone or horn with a thin membrane covering the narrow end. A bristle was attached to this membrane and rested on the smoke blackened surface of a glass cylinder.

As the membrane responded to sound waves, its vibrations caused the bristle to etch out a wavy line on the cylinder. Louder sounds caused the line to move further from side to side (greater amplitude): higher pitched sounds produced a higher rate of vibration (higher frequency).

Just 20 years later, on August 12, 1877, Thomas Edison made his historic recording of "Mary had a little lamb" and played it back—the famous "Phonograph" was here.

In its commercial form, the Phonograph was an immediate success. It was demonstrated at the Crystal Palace Exhibition in 1888 and used to record a performance of Handel's Israel in Egypt.

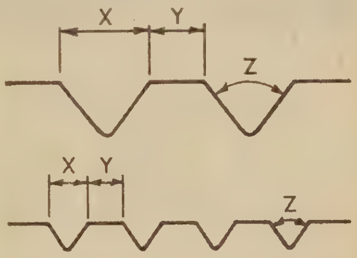

*Figure 4: The groove dimensions of standard and microgroove discs. There are 90-120 grooves to the inch on standard 78 rpm records (top), the dimensions being X 0.006 inch, Y 0.004 inch. Microgroove records have 200-300 grooves per inch with dimensions X 0.002 inch to 0.003 inch, Y 0.0017 inch. The included angle Z is approximately 90 degrees in each case, and the maximum bottom radius is 0.001 inch and 0.00015 inch respectively.*

The mechanism was reminiscent of Scott's earlier machine, with a stiff stylus attached to the centre of a mica diaphragm so that the vibrations were in and out, instead of from side to side (see figure 2). This produced "hill and dale" indentations on the soapy wax (initially tin foil) cylinder surface.

A clockwork motor rotated the cylinder at a constant governed speed, while a lead screw made the stylus assembly track parallel to the cylinder to produce a constant "groove spacing."

It was about 10 years later that Emil Berliner began to produce flat disc records instead of cylinders. These were easier to duplicate and store than the cylinders: Berliner also reverted to lateral recording in which the cutting stylus was connected to the diaphragm via a lever so that it engraved a side-to-side trace of constant depth.

This is inherently less liable to dis-

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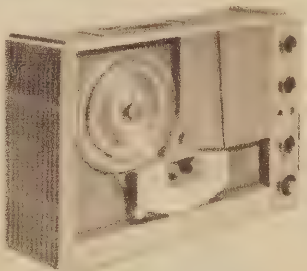

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**Table 1. Comparison of Standard and Microgroove Discs**

| | Standard | | Microgroove | | | |
|---|---|---|---|---|---|---|
| | | | Mono | | | Stereo |
| Nominal Speed (rpm) | 78 | | 33-1/3 | | 45 | 33-1/3 |
| Nominal Size (in.) | 10 | 12 | 10 | 12 | 7 | 12* |
| Outer Diameter of recorded surface (in.) | 9.52 | 11.52 | 9.52 | 11.52 | 6.625 | 11.52 |
| Inner Diameter of recorded surface (in.) | 3⅜ | | 4 3/16 | 4 3/16 | 3⅞ | 4 3/16 |
| Centre hole (in.) | 0.285 | | 0.285 | 0.285 | 0.285 or 1.5 | 0.285 |
| Average pitch (grooves per in.) | 100 | | 250 | | | 250 |
| Stylus tip radius (in.) | 0.002-0.003 | | 0.0007-0.001 | | | 0.0005-0.0007 |
| Stylus included angle | 40 deg.-55 deg. | | 40 deg.-55 deg. | | | 40 deg.-55 deg. |
| Colour Code | Green | | Red | | | Blue |

*There are also some 10 in. and 7in. stereo discs.

rtion than the hill-and-dale method here, for example, we might expect avity to introduce non-linearity by sisting downward half-cycles and op-osing upward half-cycles).

The principal disadvantage of the disc mpared with the cylinder is that, as the oove spirals towards the centre of the cord, the linear recording speed falls ntinuously. This causes a progressive amping of the recorded waveform until, wards the end of each side, the shortest avelengths (highest frequencies) can nly be inefficiently traced by the re-roducing stylus.

There are other potential causes of dis-rtion due to the changing parameters sociated with the slowing down of re-rding speed and, of course, the use of pivoted reproducing arm brings about anges in the groove-head geometry ee figure 3).

These technical pros and cons not-ithstanding, the cylinder and disc sys-ms continued in competition for some 5 years before the now familiar disc nally ousted Edison's cylinders.

In the decade 1912-1922 many homes quired gramophones, there being no dio broadcasting to compete.

Soon after broadcasting began, the pos-bility of adapting electrical microphone, nplifier, and cutter head techniques to sc recording was exploited, with a arked improvement in realism—even hen the discs were reproduced through e standard acoustic sound-box/horn amophones.

The advent of electrical recording in 25 was followed by a period of greater andardisation by the various recording mpanies.

The 78 revs. per minute turntable eed became standard, there was a rowing together" of the frequency cor-ction characteristics used by different mpanies, and the groove profile (for hat we now call "standard" or "coarse oove" discs) became as shown in figure

**Microgroove recording:** The next great ep forward was made possible, shortly ter the 1939-45 war, by the develop-ent of new plastic record materials.

Experiments with very advanced tting techniques, shallow grooves, pre-nphasis, etc., had already shown that e frequency response and playing time r disc could be substantially extended if the public could be persuaded to y lighter weight pickups .

But little progress was made commercially since the granular nature of the shellac disc material, with abrasive filler powders added, produced heavy surface noise and limited the smallest amplitude of signal that could be recorded.

When unfilled vinyl or polyethylene became available (a lightweight pickup was obligatory for vinylite, therefore no filler was necessary) it was immediately possible to make finer "microgroove" records and at the same time greatly extend the dynamic range—that is the range of intensity levels on the record.

Discs of this type at 78rpm could be made with a frequency range up to 20,000Hz. But, to increase even further the extension of playing time that the finer groove spacing (250 grooves per inch) supplied, a turntable speed of 33-1/3rpm was adopted. (This speed was already in existence for film and broadcast transcription purposes.)

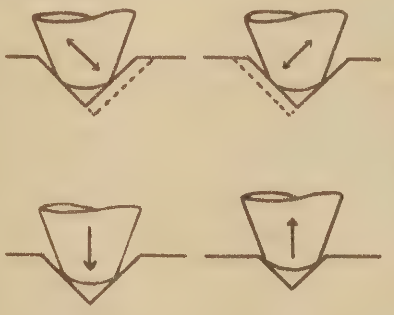

*Figure 5: Two-channel stereophonic recording. Modulation of only the Left or Right channel would produce movement at 45 degrees to the disc surface as shown. Note that if both channels were modulated equally the movement would be lateral or hill-and-dale (lower diagram) according to whether the two modulating signals were in or out of phase.*

The intermediary speed of 45rpm was introduced by RCA for 7-inch discs of shorter musical items or selections. The microgroove profile is shown in figure 4 and a summary comparison of the disc types is given in Table 1.

**Stereo discs:** To round off this abbreviated chronology, a few words on stereophonic gramophone records are necessary. Stereo tape records were on sale to the public as early as 1955, it being a comparatively simple matter to record and playback twin tracks on magnetic tape for the Left and Right channel stereo information.

The principles of stereo disc recording and reproduction had been established by A. D. Blumlein before the war. His researches anticipated all the methods of groove cutting subsequently used.

Among early methods proposed for the disc recording of stereo was a double cutter head system that cut two grooves: this led to difficulties in lowering the dual pickup head so that the two styli would register in the proper grooves, and, of course, it halved the playing time per record.

Then in April, 1956, Arnold Sugden provided an impressive demonstration of stereo from disc at the London Audio Fair and B.S.R.A. Exhibition.

He had solved the problem of recording the two separate channels in a single groove by simultaneously driving the cutting stylus from twin coils designed to produce (a) horizontal movement—the conventional lateral groove, and (b) vertical movement—the old hill-and-dale groove.

To reproduce the stereo groove, Sugden had devised a pickup head again with vertical and horizontal sensing coils so that Right and Left channel information could be induced independently.

Independent work by Arthur Haddy of Decca and Westrex in America finally produced an agreed system.

By the middle of 1958, stereo discs were being marketed by several companies, the inherent unbalance of the vertical/lateral system having been eliminated by effectively rotating the axis of operation through 45 deg. This produced the now familiar 45/45 deg. stereo groove (see figure 5) in which a signal in the Left channel produces movement in one line at 45 deg. to the surface and Right channel information corresponds to movement in a line at right angles to this.

Next month we shall see how a gramophone record is made, and study in more detail the important disc parameters. ■

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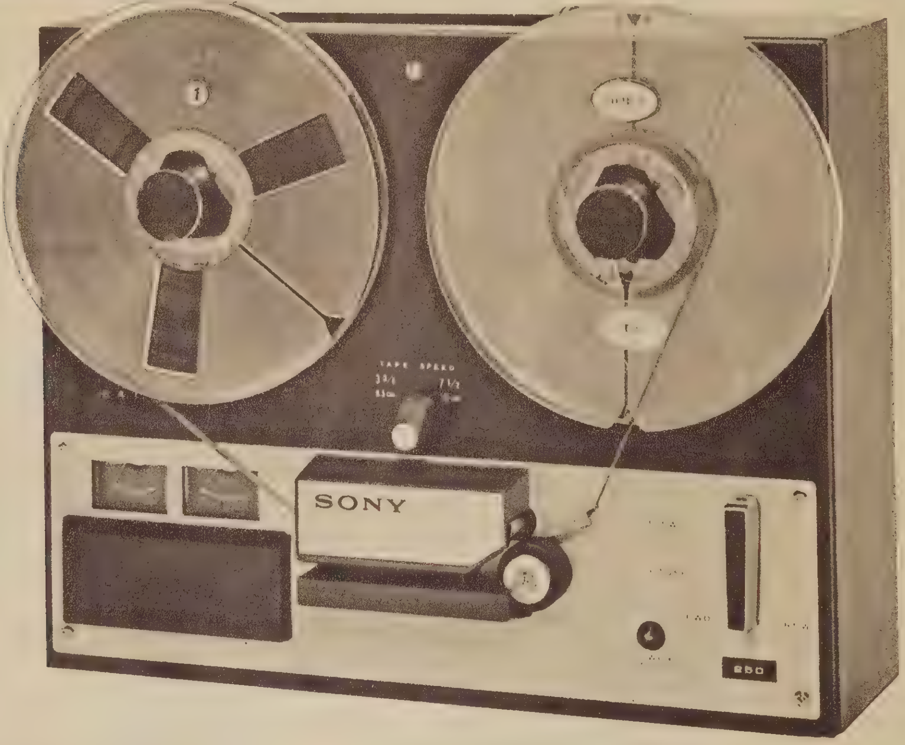

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|---|---|
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# AUDIO TOPICS

## The PWM amplifier controversy — continued

The article in these columns, in the June issue was entitled "The PWM Amplifier Controversy." In it, our Technical Editor Jamieson Rowe discussed the general principle of PWM and commented somewhat critically on the Sinclair X-20 amplifier, the most widely advertised example of the principle. We publish, with brief interspersed comment, typical letters from readers in support of the PWM system, though not necessarily in terms of the Sinclair design.

The first is a long and thoughtful ontribution from a reader in Arana lills, Qld. He writes:

"Sir,

In view of the article in the June, 966, issue presenting the case against WM, may I be permitted to present ome information in its favour? Before oing this, I hasten to point out that I o not state the case for the "X20," any one particular amplifier, but for WM in general. Any amplifier is only good as its designer allows.

"Firstly, I would like to comment on gure 3 and the author's comments on e width of the scanning slit for low stortion. In practice, with two back-to-ack diodes, the scanning slit is approxiately symmetrical about the zero line d the argument of 'unequal average odulation for positive and negative half aves, giving second harmonic distoron' does not apply.

"Even if the situation described by gure 3 did apply, it would not give se to second harmonic distortion, but a DC component in the output. This ould offset the speaker cone by a small nount, which would be negligible in actice. If second harmonic distortion d occur, it would decrease (as a perntage of the output) with increase in tput. As your own results with the 20' suggest an increase in distortion th output, this is obviously not the use.

"Secondly, the necessity to employ irly costly high frequency transistors' questionable. As the output transistors operated in a switching mode, good earity is not required and cheap icon planar epitavial transistors can be ployed. (e.g. Fairchild SE8001). In rest of the circuit, germanium drift nsistors may be employed, and these cheaper still.

"In general (for domestic audio appliions) the 'high efficiency' characteris- of PWM has application only in the luction in size of output transistors. e power consumption here is so low it power supply losses become the jor part of the power consumption. ere is also, as you have pointed out, power consumption of the rest of circuit to consider. However, 20 tts per channel can be obtained with 'M without large output transistors mounted on much larger finned heat sinks.

"In the domestic application, the output filter should be designed to pass low frequency components to the loudspeaker and switching frequency components to a resistor of high power rating. The load on the amplifier is then never reactive (and reactive loads are the major source of distortion in PWM amplifiers) though the efficiency of the output stage cannot exceed 50 per cent.

"If the resistor dissipating the switching frequency components is made four times the voice coil impedance, the efficiency rises to 80 per cent maximum, and this could be applied in PA amplifiers. This efficiency could be raised still further (theoretically to 100 per cent) by returning this energy to the power supply.

"Next, I query your comment on practical filters being inefficient. The Australian Post Office have, for many years, employed low-pass and band-pass filters with very much more stringent design requirements than necessary here. The losses involved in these filters are very low. Admittedly, the PWM output filter cannot be designed on an image impedance basis, due to input and output impedance characteristics, but modern network design will cater for this contingency. A very simple filter is shown in 'Wireless World,' August, 1965, by D. R. Birt.

"You say that 'With transistors the problem of producing a linear triangular wave at 50-100KHz is, if anything, harder than, achieving linear audio amplification.' Mr Birt (W.W., Feb., 1963) states that better than 0.25 per cent harmonic distortion is easily obtainable with conventional Miller or Bootstrap integrators. This is achived with one transistor in most circuits, and this transistor is also generally used for Audio amplification, resulting in considerable deviation from optimum design on the integrator (see 'Open Loop Amplifier,' Turnbull and Townsend, W.W., April, 1965). Very much better results are obtainable with multiple transistors. Note also the ease with which this linearity can be modified to cancel nonlinearities in the rest of the system.

"The 'spurious and unwanted modulation products' can be made negligible by proper attention at the design stage. These, in fact, are heterodynes between the switching frequency and harmonics of the modulating frequency, and become troublesome only in the 'open loop' system. Even in the open loop system, provided that the modulation index is kept low, the problem is minimal. The beat between the switching frequency and the third harmonic of the modulating frequency is 36dB down at 20 per cent modulation index.

"The problem is worse at higher values of modulation index, but these occur in practice only on the low frequency components, and these beats will

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The source of supply of the B.B.C. Gramophone Library is world-wide. In 1964 alone, 30,000 commercial gramophone records were added to the library. Every new release issued in Britain is bought—and in the case of artists currently most in demand, this can mean a dozen or more copies of one record. Gramophone records from abroad are purchased on a selective basis, but their enormous range can cover anything from a Maori chant to the newest symphonic work from a European Festival.

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In recent years the extension of broadcasting hours and new developments in the B.B.C.'s domestic services and overseas services have presented a special challenge to the resources of the library. This is being met not only in the volume of gramophone records acquired, but in their increasing diversity of interests. The acquisition of records in stereo as well as mono, the widening range of educational subjects, experimental music and the collection of records from abroad—these and other factors make the B.B.C. Gramophone Library a unique treasure house among broadcasting organisations in the world.

be still well above the audio band. (Incidentally, from your oscillograms, the modulation index appears to be about 40 per cent and this and higher levels could cause difficulties with heterodyning.)

"If the closed loop system is used, no difficulties with heterodyning are experienced in practice, though the switching frequency drops on high modulation ndexes to very close to the audio band.

"Next, a properly designed low-pass filter will not present a high impedance o the loudspeaker. In fact, by using gated feedback as suggested by Birt W.W. Feb., 1963), which is motional feedback from the loudspeaker, we get much better results than high damping factors can give. This can be done with only two additional transistors. Note that his cannot be done with linear ampliiers.

"Shielding from radiation can be ffectively done by shielding the ampliier and low-pass filter. There is no need o shield speakers and speaker leads if good low-pass filter is used.

"Open loop amplifiers can be connectd so that their carrier frequencies are ocked and mutual interference cannot ake place in stereo applications. Also, mutual interference in the closed loop ystem takes place at variable frequenies depending on the modulating index. This is not as troublesome (tuner wise) s unlocked open loop heterodynes. In oth cases, they do not appear to be roublesome audiowise as the speaker ones cannot move at this frequency.

"High dissipation in the output tranistors occurs due to reactive loads. These high reflected voltages can be emoved and the dissipation reduced by iode shunting (see W. W. March, 1963, uly, 1965). This removes the need for eat sinks in the output. If silicon lanar epitaxial transistors are used, the urnover frequency is 10-100MHz and he leakage current problem mentioned oes not occur.

"A unity mark/space ratio under uiescent conditions is normally maintained by using proper design techniques. f the square wave generator and interater are symmetrical, or even approximately so, the mark/space ratio gives o trouble. Some problems can occur ue to unbalance in the output stage ut capacitive coupling is normally used ere. If very high quality is required, he output stage can be bridge connected nd the balanced output capacitively coupled and DC restored before feeding o the filter. This gives a frequency resonse to DC.

"High frequency bias supplies used in ape recording operate in the same manner as a PWM system, except that a ne wave is used instead of a triangular ave. Thus this system has the same heoretical limitations a PWM system as, except for the additional non-nearity introduced by the sinusoidal ave form. The high quality obtainable n practice from tapes shows that PWM capable of good quality.

"On a theoretical and practical basis, appears that the closed loop PWM stem gives good linearity with low disrtion and minimum cost. This system an give results equal in quality to the est linear system, with very much less ringent power supply requirements articularly regulation). The open loop stem is capable of results exceeding he best linear system (when gated feedback is used) but power supply requirements are much more stringent, and the complexity is great.

"Closed loop systems appear to have application in the high quality transistor amplifier field, where presently it is difficult to economically build linear amplifiers to compete with vacuum tubes.

"Open loop amplifiers have application for the purist, who wants the perfect amplifier to suit his acoustically designed listening chamber. He can determine the motion of this loudspeaker cone independently of the speaker characteristics, he can split his signal into high and low frequency bands in a preamplifier stage, use two separate amplifiers and drive his 'woofer' and 'tweeter' from low source impedances even at crossover frequencies, and he can pay for the complex circuitry that all this involves as purists have always been wont to do."

B. O'N (Arana Hills, Qld.)

## Comment by the Technical Editor

**Mr Rowe:** I must first of all say that I'm pleased that it has proved possible to print this correspondent's reply to my article. Although to my mind the points he raises do not alter the basic situation presented in the article, they certainly represent the PWM situation viewed in an optimistic light and should thus tend to help readers in arriving at an objective appraisal.

Despite my attempt to be objective it was inevitable that the article reflected to some extent my own appraisal which was undoubtedly coloured by our ex-

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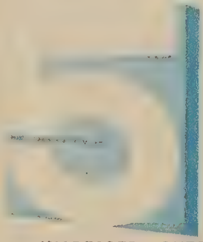

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eriences with the several X-20 units, hich we had for examination.

This said, however, there are a few oints raised in the letter to which I nust reply. And the first of these re- uires an apology: I must with red face gree with B. O'N. as to the falsity of he statement I made asserting that both edges" PWM is prone to an dditional source of second-harmonic istortion with a clipper-type scanner. ubsequent re-checking has vilified this ssertion, showing that such distortion oes not occur and that as our corres- ondent states unequal average modula- on would in fact result in a small D.C. omponent.

*At an exhibition staged at Worthing, Sussex, three brothers, Peter, Trevor and Richard Pannell, examine the largest record ever made. A Pathe disc, 20 inches in diameter, it was made in the early 1900's and spins at 120/130rpm. The item is "Mary of Argyll," played by the band of H.M. Scots Guards.*

To my mind this correction does not itiate the case in any way, however. It mply suggests that the distortion which evident must come from the other otential sources.

The tendency for Sinclair X-20 ampli- ers to produce a "static" displacement f loudspeaker cones has already been ıe subject of considerable comment and ne can't help but wonder how much isplacement of one kind and another 'pical loudspeakers will tolerate without producing serious distortion.

To the second point raised by the orrespondent I feel I must reply that lthough good linearity is admittedly not equired—the article in fact pointed this ut—it certainly is essential that the ages exhibit good high frequency re- onse if the overall efficiency is to be ept up and the output stage dissipation to be kept down. Both these perfor- ance criteria are fairly obvious func- ons of the rise- and fall-time of the WM signal.

With regard to the assertions about e relative prices of silicon and ger- anium devices I frankly doubt whether, far as the home constructor is con- rned, the germanium drift devices ould prove cheaper than silicon planar vices. Also I note from the latest in- rmation at my disposal that the price the SE8001 silicon power device oted, in 1-99 quantities, is $2.70 plus x—which is some 40c dearer than the 2147 germanium power drift device ed in our own and other high-quality ear amplifier designs. Hard commer- al fact thus does not seem to support our correspondent's somewhat optimistic claims, particularly if one remembers the additional circuitry involved in a PWM system.

As far as I can see the remainder of B. O'N.'s letter needs no comment from me. As I mentioned above it does not seem to alter the basic situation which I tried to present in the article, but simply seeks to represent matters in a more favourable light. Whether it is successful or not is a decision which must be left to the reader.

## Another critic

Another letter in reply to the June article makes the following comments:

**From J.A., Cobar, N.S.W.:** "The statement that 'both edges' PWM was easier to arrange than 'one edge only' puzzled me. This may well be because I know little about PWM, but it seems to me that the modulator for 'leading edge only' PWM would comprise a sawtooth voltage generator (surely simpler than one for generating an isosceles triangular voltage) and a level sensitive switch (monostable flip-flop).

"The point on the 'front edge' of the sawtooth of which turn-on occurs would depend on the instantaneous value of the audio voltage, while turn-off would occur at the 'back edge' of the sawtooth. Assuming a linear 'front edge,' and a steep 'back edge' for the sawtooth, then the period of the output square wave would remain fixed while the mark-space ratio would vary with the audio voltage. Adjustment of the mark-space ratio to unity with zero audio input would be by means of bias adjustment of the Schmidt trigger.

"A point regarding PWM amplifiers on which Mr Rowe was particularly harsh (and I fear not altogether fair) was the matter of power output. As it seems to me a major part of the 'for' case in the PWM controversy, I feel it deserves more comment.

"The comment that a PWM amplifier would have an efficiency of only 65 per cent in the output stage may well be correct. Since the overall efficiency of a class B amplifier is 70 per cent (55 per cent for the complementary symmetry mode — Radiotronics 2, 29 (Feb., 1964), 34), there is little to choose between the two in terms of overall efficiency. But this is not the full story, and indeed seems barely relevant to the main proposition.

"The case for PWM as I understand it is that the dissipation in the output transistors is much less when they operate in a switching mode than when they operate in class B.

"Maximum dissipation for the transistors in a push-pull output stage occurs when the output power is about 50 per cent of the maximum available power (onset of clipping), and is roughly 40 per cent of that maximum output. (Radiotronics 2, 29, 44). If we assume that dissipation for the transistors when operated switching mode (sometimes called class 'D') is 20 per cent of the maximum output (10 per cent to 15 per cent would probably be a better estimate!), then class D operation instead of class B would allow either twice the output power for the same dissipation, or operation at the same power level for only half the dissipation.

"Losses in a filter would need to be immensely greater than in an output transformer to nullify this sort of advantage since, with the transistors operating at below their turnover frequency,

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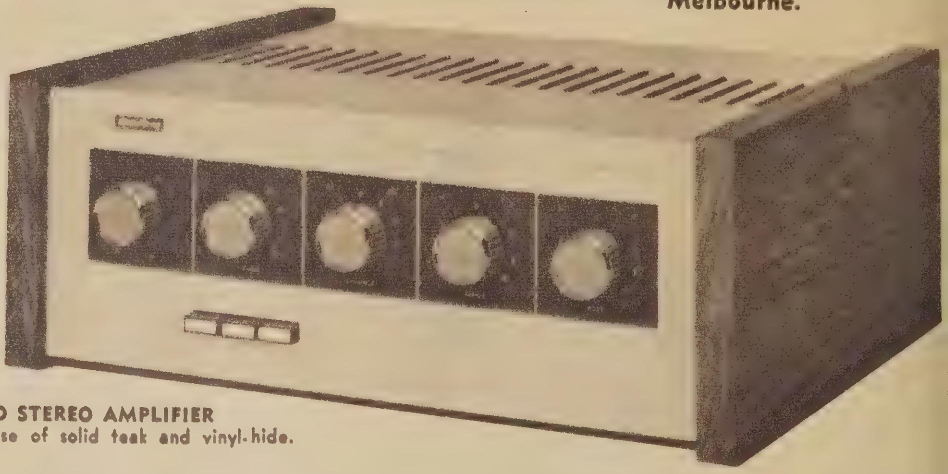

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heir dissipation should be nowhere near s high as 20 per cent of the output ower.

“I feel that Mr Rowe's article would ave been more in keeping with 'ELECTRONICS Australia's' previous policy and also the old idea of 'fair go') if he ad concluded somewhat in the followng manner.

“So there you have it. The X-20 nit produced some peculiar wave forms, nd obvious distortion on sine wave ests even at low output levels, so there eemed little point in checking the maxinum output. These shortcomings are ardly surprising in view of the unmbitious nature of the modulation circuitry, though it should be remembered hat this unit, fully assembled, tested and tax paid sells for under £stg10 in the U.K. ($A25). In this price range, the manufacturer's claims would generally be regarded with some caution.

“On the other hand the unit sounded surprisingly good on music, and if a preamp providing suitable pickup equalisation were used the results should be acceptable to many persons. Whether this unit, with its possible shielding problems, is worth the price asked for it in this country is something the reader will have to decide for himself. We ourselves feel that this is doubtful.

“Such an ending would eliminate the 'I don't think PWM amplifiers are really worth the trouble involved and this one proves it' implication which I at least read into Mr Rowe's article.”

## Several points open to question:

**Mr Rowe:** I'm afraid the corresponent is incorrect in assuming that it is asier to generate a supersonic sawooth than a triangular waveform. Genration of the latter is simply a matter f integrating a square wave, as the rst correspondent noted, although, to rrive at an accurate triangular wave, oth the square wave and the integraon must be accurate. However, to enerate a supersonic sawtooth one must ther integrate a suitably spaced series f very narrow pulses, or start straight ff with a linear sawtooth generator. ither way the job is harder than in e triangular waveform case, due to e need to achieve a rapid flyback or ack edge.”

I am in full agreement with the genal theoretical argument in favour of e high efficiency of an ideal PWM utput stage; in fact, as I stated in the ticle, it is fairly easy to justify such aims even from a qualitative viewoint. However, as I also sought to ow, it is one thing to have a theoretil advantage but quite another thing realise the advantage in practice. If ficiency is not achieved it increases the wer supply requirements but, contrary what J.A. seems to imply, it also ineases dissipation in the output transtors. In short, as stated in the orinal article, frequency response, efficicy, transistor dissipation and power tput are all highly interdependent.

I would be among the first to admit at one can realise an efficiency adntage with PWM — but at what st! By the time one has ensured that triangular wave is linear (or suitably n-linear, as the case may be), made re that it is modulated and scanned operly, amplified it without degrading transition times or distorting its ark-space ratio, and finally filtered it ectively and efficiently to pass on to speaker, things have surely strayed from the original aim to produce amplifier physically, electrically and onomically preferable to the wellablished linear variety.

Frankly, although I do not wish to ter into further debate on the subt, I still find myself siding with those o find PWM little more than an riguing way of attempting to do an eady well-done job in a much harder hion.

I leave the questions regarding my atment of the X-20 amplifiers and ether I was unfair or not to the Edi- who makes a comment below. Howr I think it is worth mentioning at this point that, in recent advertisements in overseas magazines, Sinclair Radionics appear to have reduced emphasis on the X-10 or X-20 amplifiers, concentrating on their other products, which are not under discussion. Perhaps I should also mention that, since the June article appeared, I have received a number of phone calls expressing appreciation for our frankness in publishing our findings.

**W. N. Williams, Editor:** I must take up J.A. on his reference to a change of policy and a “fair go.” We have always maintained the right to criticise where this seems to be called for and it has been exercised frequently enough in regard to other products, to books, records and tapes, submitted to us for review. To withhold criticism which seemed called for would be denying readers the “fair go” which they have a right to expect. In assessing the amplifier, it was reasonable to do so against the advertised claims, which nominated figures directly competitive with high fidelity amplifiers; this would be the basis on which prospective buyers might find it attractive. The suggested alternative phrases such as “the manufacturer's claims would be regarded with some caution” merely use nice words to cast doubt on their veracity.

## Agrees with us:

Among those who have not been impressed by the performance of the Sinclair PWM amplifiers is a reader from Pascoe Vale, Victoria, who writes as follows:

“Your article in the June issue of 'ELECTRONICS Australia' on PWM amplifiers came as a welcome surprise. Having had a good deal of experience with the X-10 and X-20 amplifiers, I found that your words echoed mine exactly.

“On a Tektronix CRO, the X-10 gave quite a good triangular wave from the Miller integrator but the modulation method (passive mixing!) would appear to be its main downfall. The X-20 has an extra isolating resistor in the audio feed but still only passive mixing.

“The X-10 has a Schmitt trigger which feeds the output transistors with a very 'rolled off' square wave. Little wonder that the output transistors get hot!

“X-10s give about 2 watts (estimated) of fair audio power from a regulated 12-volt supply and a 15-ohm loudspeaker. Note that there were several models of the X-10 with different transistors and multivibrator frequency.

“In the 50KHz model, the beats of harmonics of AF with square wave caused very noticeable whistles in the speaker.

“Some references to PWM you may be interested in include: Proc. I.R.E.E. Aust., May 64, 314-323. Electronic Engineering, Aug., 65, 540-542. 73 Magazine, May, 64, 26-32. Audio, Sept., 65, 19-22.

“Clive Sinclair also has words in Wireless World, June, 65 (p. 289) and gives the impression that distortion figures have been calculated rather than measured.” (J.H.)

**W. N. Williams, Editor:** Such then, is typical argument which has flowed from our PWM article in the June issue. It will be apparent that the main concern of the contributors has been to defend PWM as a principle, without specific reference to the Sinclair designs, as examples of the principle. The discussion may not be finished yet, of course. But, in the long run, time alone will tell whether PWM will prove to be technically and economically attractive or whether it will turn out to be merely a more difficult way of doing something that is already done well by conventional means.

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# Classical reviews

By JULIAN RUSSELL

## Reissue of Famous Tristan Set

**AGNER—Tristan and Isolda. Complete Music Drama. Kirsten Flagstad (Isolda); Blanche Thebom (Brangane); Ludwig Suthaus (Tristan); Josef Greindl (King Mark); Dietrich Fischer - Dieskau (Kurvenal); Edgar Evans (Melot); Rudolf Schock (Shepherd and Sailor); Rhoderick Davies (Steersman). Philarmonia Orchestra and Chorus of the Royal Opera House, Covent Garden, conducted by Wilhelm Furtwangler. HMV Everyman Opera Series HQM1001-5.**

This is the 1953 — mono, of course— Tristan" re-issued by EMI under their ew economy priced label, The Every-an Opera Series. It is now on five in-ead of six discs, the transfer having een made without any loss of tonal uality. When it was first issued it aused a stir, not only by virtue of its plendid cast, conductor and orchestra, ut because of its engineering too. Engin-ering has come a long way in little ore than 12 years, and Decca's stereo ristan, put out in 1961, was also rap-rously greeted for its many fine feat-res. So far as the actual singing is oncerned the earlier one has not been xcelled.

Nor, despite Solti's magnificent orches-al performance for Decca, has Furt-angler's reading been equalled. I now of no other conductor of recent ears who could make the first bars of he Prelude yearn in the way Furtwang-r did. But before going on to review he vocal aspects of the performance I ad better settle the question of e orchestra. No reasonable listener ould expect to hear, in a 1953 record-ng, the orchestral detail audible in the etter recorded stereos of some years ter. Inevitably some must be lost. Nor the balance in the older version as nsitive as Decca's. There are moments hen either the voices obliterate the rchestra or vice versa. But these are ot frequent enough to cause irritation, nd buyers who know the score should able to supply what is missing with eir mind's ear.

But I must hasten here to add that espite these signs of age the original MV set is still well enough engineered reveal the splendour of Furtwangler's ading of this passionate music and the ertness of response and magnificent aying of the Philharmonia Orchestra nder his inspired direction. And Furt-angler was able to communicate this me elation to the singers, especially in e case of Ludwig Suthaus' Tristan, ite surprisingly. (About which more ter).

Flagstad was in full possession of all r marvellous gifts when she recorded 's performance. Here you have one of the finest Isolda's of the century in a performance that has ever since challenged successful comparison. She is at once ardently committed to the role—by no means too cold or statuesque as has been said—and with her vocal and dramatic equipment unimpaired presents a reading that is mature yet femininely wilful. Hers is no girlish Isolda but a woman in the grand manner realising to the full the dangers of the step she is taking by leaving her medieval husband for her lover. Her voice I can only describe in one word, glorious, her technique completely assured, her range of expression vast.

I must confess to being surprised, after having heard other Tristans, both recorded and live since I last listened to this set, at realising the magnitude of Suthaus' achievement in the role. He is heroic yet always romantic, never sacrificing beauty of tone to dramatic effect, yet always realising the full dramatic import of every bar he sings. Splendid all through the first two acts, he rises to supreme heights in the last. The fact that he is never overshadowed by his great consort reveals just how impressive his performance is.

No one will be surprised to hear a splendid Kurvenal from Fischer - Dieskau, probably the most versatile artist singing today. He can sing anything he is asked for, lieder, German and Italian opera, French songs, and in all is usually better than any rival. In this recording he manages quite extraordinarily to project a rough, honest, soldierly character by the use of a technique that never achieves less than the ultimate in refinement. His devotion to Tristan is complete, his manner of expressing it peerless among present day singers.

Neither in this set nor in the later Decca is the role of Brangane quite satisfactorily performed, but of the two I have a slight preference for Blanche Thebom in the one under review. While never quite realising all the subleties of the part she comes closer to a realisation of the very difficult role than does Regina Resnik for Decca.

In the engineering you will not hear anything with quite the startling quality of, for instance, Decca's Prelude to Act 2, with, on curtain rise, the wonderful perspective of the receding hunting-horn calls. As I wrote earlier you may, too, miss an occasional favourite orchestral passage. Some of the refinements of Wagner's divisi string passages during the quieter parts of the second act love duet must be guessed at rather than heard, as they can be in Decca's. But Furtwangler's interpretation, despite the earlier engineering, remains one of the greatest within living memory, and one to which I can still respond with the rapt enjoyment of my past youth.

He has long had a reputation for slow, ponderous German tempos, but nothing could be further from the truth here. You have all the langour of love sickness which, if anything, increases its voluptuousness. To confirm this, try the Prelude to Act 3, where the temptation to linger is resolutely refused; or the "night" passages in the second act love duet with their suggestion of entwined bodies. Its notes melt into one another in marvellously shifting chromaticism, yet the impetus never falters.

There is another change worth mentioning, in addition to the transfer from six to five discs. HMV have provided a new English translation of the libretto, by R. B. Moberly, that I have never come across before. Syllabically it fits the music to perfection and much of it has high literary merit. There are, however, some extraordinary lapses into banality, especially when he has Kurvenal telling Isolda and Brangane to "rise and shine." But, with all its shortcomings considered, this set, at the selling price of just under $20, is bound to be one of the best bargains of the year.

* * *

**VERDI — Don Carlos. Complete Opera. Carlo Bergonzi (Don Carlos); Renata Tebaldi (Elizabeth de Valois), Nicolai Ghiaurov (Philip II); Dietrich Fischer-Dieskau (Rodrigo); Grace Bumbry (Princess Eboli); Martti Talvela (Grand Inquistor); Jeanette Sinclair (Tebaldo); Kenneth Macdonald (di Lerma). Chorus and Orchestra of the Royal Opera House, Covent Garden conducted by Georg Solti. Decca Stereo SET305/8.**

From time to time since it was first written —immediately before Aida — five versions of Don Carlos have been presented in different opera houses. The work was never popular in Verdi's lifetime —a fact that is difficult to understand nowadays — and he made many revisions. The version offered here is the complete one, Verdi's final revision, with the undistinguished ballet music dropped and the infinitely superior prelude to Act 3 added. This means that the present set includes the splendid Fontainebleu scene which was omitted from the performance I attended in Vienna last year.

It is a splendid reading directed with all Solti's zeal for picturesque detail without, however, impeding the work's grand sweep towards its end. The singing is unfailingly good though, in some of the roles, not very exciting. The outstanding performances come from Bergonzi and Ghiaurov. The latter was the Philip I heard in Vienna and the night I was there he held up the show for a quarter of an hour after his singing of "Ella Giammai M'Amo." His is a magnificent portrayal of the gloomy, irresolute monarch, his voice rich and smoothly used throughout the entire range and unremittingly expressive.

I have never before heard Bergonzi sing as sweetly or in such exquisite taste as he does here in the role of the Don. And his honeyed tone never detracts from the vividness of a dramatic situation or from the intensity of the emotion he wishes to convey. Next in importance among the males is Fischer-Dieskau, as perfectly at home in this Italian setting as he is in German lieder, Wagnerian or Straussian opera, or, for

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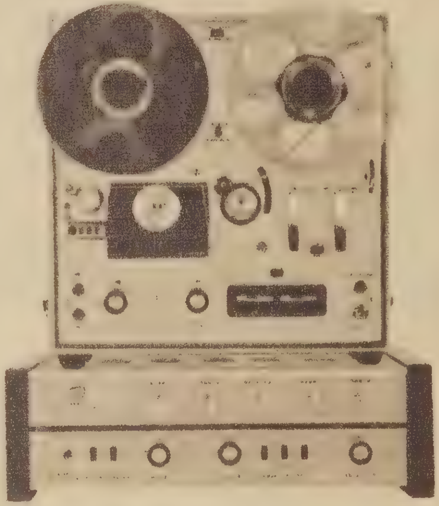

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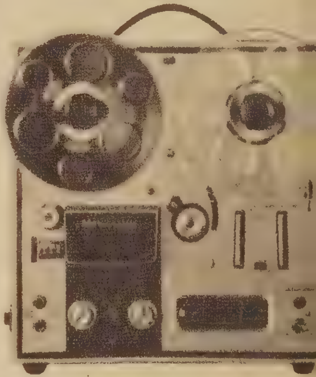

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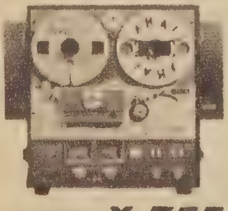

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ıt matter, the essentially English War quiem of Benjamin Britten. In only e scene does he fail to get the utmost t of his part — in the duet with iaurov where the two try to "stop" ch other in a manner that is far m becoming.

I cannot praise the women with the me enthusiasm. Tebaldi (Elizabeth) gs with all her usual good sense of le but the extremes of her register, any rate in this recording, seem to ow ever so slight evidence of wear. least, that is the impression I got cause of the care with which she now es them. Grace Bumbry's Eboli is curately but rather academically sung, it was in Vienna. She never sounds mfortable in the coloratura passages the Moorish song, and even where e is obviously quite at ease she selm abandons herself to the music.

In the smaller role of the page Jeante Sinclair is always a delight.

The orchestra and chorus under Solti mbine to bring off some grand enmbles — of which there are many— d both are unfailingly alert to the nductor's exacting wishes. The balce is always scrupulously observed tween voices and orchestra, both in los and concerted numbers. But even ter playing some of the passages with fferent styli I could not eradicate an casional fuzz on the edge of some of e voices. This doesn't often happen ring the recording, but when it does is disturbing. A little more serious, d I should have described it as disrtion.

* * *

**RAHMS—Symphony No. 2. in D Major, Op. 73. Vienna Philharmonic Orchestra conducted by Istvan Kertesz. Decca Stereo SXL6172.**

There have been many fine recordings Brahms' four Symphonies, some since leted, others still available. But here one that I prefer to all others, on the ore of the interpretation, the orchestral aying and the recording. You, too, ay well have a favourite recorded perrmance which you might defend ainst all comers on perhaps the merits one or even two of the features I've st mentioned. But I know of no other rsion that can successfully challenge l three. I shall give myself the pleasure listening again to it in retrospect as briefly run through some of its auties.

In the first movement there is the ken phrasing of the marvellous Vienna ilharmonic Strings at their first imrtant entry, then their vigorous bowg at a pace solidly steady yet never nderous. When they play with the rest the orchestra the ensemble is impecble. Kertesz is one of those conductors o by skilful, imaginative control of lance can avoid clotting of the inner ices of the score that occurs if ahms' markings are too slavishly obved. The result is refreshing clarity led by beautifully separated stereo gineering and a wide dynamic range it is never over-exploited. Dainty entuation of the woodwind parts kes piquant contrasts.

The opening of the second movement all sweetness and tenderness, a fitting lude to the more impassioned developnt section. The music climbs in a ep but not too precipitous curve before declining throbbing into a pianissimo ending.

In the first subject of the graceful third movement the woodwinds come into their own, especially the oboes, using the neatest imaginable, elegant phrasing. The second theme has real vigour and busyness, a pleasant change from the treatment allotted it by many other conductors.

The final allegro con spirito doesn't sound like a moderato movement speeded up, as it so often does. It has genuine fire. It was perhaps against Brahms' nature to keep this sort of thing up, though Kertesz does his best to do so for him, but always within the strictest bounds of good taste. If you haven't so far acquired a Brahms Second, don't hesitate over this one. If you already have one, however much you like it, listen to Kertesz and the Vienna Philharmonic's performance.

* * *

**MOZART—Mass in C Minor (K. 427). Edith Mathis (soprano); Helen Erwin (soprano); Theo Altmeyer (tenor); Franz Crass (bass); South German Madrigal Choir and South German Chamber Orchestra conducted by Wolfgang Gonnenwein. World Record Club Stereo ST/4034.**

Very little of Mozart's sacred music finds its way on to the market here, if, of course, the Requiem is excepted. Mozart left the C Minor Mass unfinished, as he did the Requiem, and the missing movements of both were later added by "editors." While this tends to make both works uneven, there is much that is pure gold in both. The C Minor receives fewer performances than it might if it were less difficult to match two sopranos in their important parts. But this problem has been brilliantly overcome by the Columbia casting department. Edith Mathis and Helen Erwin are so admirably teamed that not even the keenest-eared listener can always be sure which of the two is singing.

The singing of these two ladies is far and away the best feature of the whole performance. The tenor, Theo Altmeyer, is never less than competent, but it is difficult to find anything else in his performance to recommend. Nor is the bass, Franz Crass, any more exciting. The chorus is admirably disciplined and the orchestra efficient, but neither are exploited to their full by the conductor, Wolfgang Gonnenwein. He is a young German who has made something of a name for himself in Germany by performing eighteenth-century music and some from earlier periods. Kindly, his direction could be described as uninspiring.

You might, if you decide to buy the disc—and it is well worth while having despite its shortcomings—try to identify which of the two sopranos is delighting you at the moment. By the order of the names, I take it that Mathis is the singer of the Kyrie, a performance which, after the commonplace nature of what had gone before, brought me bolt upright in my chair. And if this is Mathis it must be Erwin who is heard in the Laudamus, another voice delectably pure in tone and fluid in coloratura. You might also be interested in a phrase in the Gloria that can be heard in the Halleluyah Chorus in Handel's Messiah. The engineering is clear but without much character.

**MOZART—Complete Dances and Marches. Vol. 4. Contredanse "La Bataille." (K.535). Minuets (K.103) Nos. 1-6. Contredanse "Il Trionfo Delle Donne," (K.607). Minuets (K.103) Nos. 7-10. March in D (K.445). Minuets (K.103) Nos. 11-14. Five Contredanses "Non Piu Andrai" (K.609). Minuets (K.103) Nos. 15-19. Vienna Mozart Ensemble conducted by Willi Boskovsky. Decca Stereo SXLA 6197.**

Here is more Mozart, of a different kind altogether and played quite differently, too. Among the composer's other many jobs was the provision of music for such ceremonial occasions as State balls and other functions. This was no chore to him since he himself was an ardent dancer and, I suspect, jotted down all kinds of ideas, as they occured to him, that might be useful for this medium. At any rate the collection offered here is exquisitely graceful and gay and displays Mozart's wonderful resource in scoring for small groups of instruments.

Here is true rococo elegance of untarnished freshness and imperishable vitality. In an occasional contredanse Mozart uses a well-known tune. Non Piu Andrai from Figaro is featured in one. And in this he interestingly omits violas from his score for strings, flute and drums. It is quite enchanting in its unusual attire.

The way the program is set out it can be played right through without monotony. But this is due, not only to the imaginative lay-out, but also to the altogether bewitching playing of the Viennese group whose members obviously love every note they are producing. This is Volume Four, and the first one to come my way. It is of a quality that makes me regret having missed the previous three.

* * *

**MOZART—Overtures Le Nozze de Figaro; Don Giovanni; Cosi Fan Tutte; La Clemenza di Tito; Die Entfuhrung aus dem Serail; Die Zauberflote; Maurerische Trauermusik; Adagio and Fugue in C Minor (K.546). New Philharmonia Orchestra conducted by Otto Klemperer, Columbia Stereo SAX02587.**

There might well be many readers who will dismiss this "selection" on the grounds of familiarity with the material —except the Masonic music and the Adagio and Fugue. I can only urge them to listen to one of the pieces played here with such perfection of style and execution before they decide against this entirely admirable disc. For Klemperer displays no symptoms of his great age. On the contrary, he has never been more spry, indeed seldom have I heard him so alert and sprightly.

He has managed to maintain towards this music such an attitude of unimpaired freshness that one might be enjoying many of these overtures for the first time. In Figaro, for instance, he makes no effort to race the clock, as Beecham was sometimes indiscreet enough to try. But he still manages to produce an atmosphere of light-hearted bustle without confusion or even undue hurry. Every bar preserves its own identity and make its own contribution, in exactly the right way, to the whole. It is a miracle of scaling—and unchallengeable correctness.

Il Seraglio has about it the complete happiness of unclouded childhood, in perfect keeping with what follows in the opera. Klemperer is careful, in Don Giovanni, not to let the general high spirits of the writing overlie its fundamental seriousness. And again every one of the thousands of notes falls inevitably into exactly the right place. This same precision and clarity makes of Le Clemenzo de Tito and the Magic Flute unusually enjoyable performances.

The two lesser known works are also a joy. The Masonic Funeral Music has solemn austere beauty, made to seem all the more grief burdened by the stereo separation. This was not achieved by any ping pong gimmickry but by Klemperer's placing his first violins on his left and his seconds on his right, as was the custom till comparatively recently. It greatly enhances the antiphonal effect of Mozart's scoring.

The Adagio and Fugue in C Minor is also a well worthwhile acquisition for any Mozart lover. The Adagio is full of rich chromatic harmonies, quite wonderfully daring for the period in which they were composed. Klemperer gives it enormous solidity while retaining the utmost sensitivity of phrasing. The fugue, crystal clear in outline in every voice, again demonstrates Klemperer's wisdom in separating his violins.

## *BRIEFLY . . .*

**VICTORIA DE LOS ANGELES. A World of Song. Thirteen songs, mostly of light character, accompanied by the Sinfonia of London, conducted by Rafael Fruhbeck de Burgos. H.M.V. Stereo OASD651.**

Although the program is light in character, the singing is worth the close attention of anyone who likes music, whatever its weight. Generally speaking, the Spanish numbers are more satisfactorily delivered than the German ones, but all are enjoyable. And the accompaniments are exemplary.

**CARL ORFF.—Carmina Burana. Dramatic Cantata on Canciones Profanes. Agnes Giebel (soprano); Marcel Cordes (baritone); Paul Kuen (tenor); the Chorus of the West German Radio conducted by Wolfgang Sawallisch. World Record Club, Mono 6022.**

This is a re-issue, put out at a club price, of a work that had a great vogue some 10 years ago. It still retains much of its vitality and its humour has proved indestructible. But it is time a more modern version found its way to the market. If you haven't got a copy, it's well worth the modest investment.

**VICTORIA.—Mass "Quarti Toni,"**
**Motets. Philippe Caillard V**
**Ensemble. Record Society, St**
**S/6178.**

A workmanlike performance
recording of one of the best-kn
Masses by the great Spanish comp
of the sixteenth century. Should ap
to anyone interested in the music
that period and to all students
liturgical music.

**PETER LESTCHENKO (baritone) s**
**Russian Songs. World Record**
**Connoisseur Series, M**
**CE/3035.**

This is also a disc of light
mostly nostalgic in mood. The 16 s
songs have been transferred from
made in the late 1920s and 30s. T
bear only their Russian titles and
text accompanies them, which m
reduce their appeal to Australian buy
The singing, however, is delightf
flexible and idiomatic.

**BELLINI.—Norma (Highlights).**
**Sutherland; Marilyn Horne; J**
**Alexander; Richard Cross. Lon**
**Symphony Orchestra and Ch**
**conducted by Richard Bony**
**R.C.A. Stereo, LSC2842.**

The great Australian soprano at so
times her best and occasionally a
below it. But will certainly be snap
up by her countless admirers.

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GE:F

# DOCUMENTARY RECORDS

## *Reviewed by Ellis Blain*

**ANS CHRISTIAN ANDERSEN: THE LITTLE MATCH GIRL AND OTHER TALES, read by Boris Karloff. Philips Caedmon TC 1117. BORIS KARLOFF READS THE UGLY DUCKLING AND OTHER TALES BY HANS CHRISTIAN ANDERSEN. Philips Caedmon TC 1109.**

At first imagining, it is bizarre, to / the least, for the king of horror in cinema to be reading fairy stories children but Karloff is not miscast. fact, it would be hard to find a better more sympathetic teller of these clas- stories for children of all ages.

Hans Andersen was an odd character life, to say the least, as his associa- n with Charles Dickens illustrates. ckens grew to dislike him so intensely at he could not bear to be in the me house with him. Surely, it is not reasonable to assume that some of author's eccentricities have found eir way into his writing, thereby ex- aining, to some extent, their total un- itability now and then for the juvenile dience to which they are ostensibly dressed.

But children quickly make adjustments d, on these records at least, both selec- n and presentation are so expertly ntrived that even an audience of con- nporary juveniles will take to them thout hesitation or reservation. But, the ultimate assessment, I should not surprised if it is the parents who d most enjoyment in the easy repeti- n which these records make possible.

Apart from "The Little Match Girl," first disc contains "The Swineherd," he Top And The Ball," "The Red oes" and "Thumbelina" while the sec- d has "The Ugly Duckling," "The epherdess And The Chimney Sweep," he Princess And The Pea," "The Col- ," "Clod Poll" and "The Fir Tree."

* * *

**HE LETTERS OF G. BERNARD SHAW TO THE ACTRESS ELLEN TERRY. Philips Literary Series B94034L.**

This is great documentary, the cor- spondence of two famous and remark- le figures, personal and private, re- aled after Ellen Terry's death, with aw's approval and accompanied by a ically Shavian Preface which conclud- with these words:

"She became a legend in her old age; but of that I have nothing to say; for we did not meet, and except for a few broken letters, did not write; and she never was old to me. Let those who may complain that it was all on paper remember that only on paper has humanity yet achieved glory, beauty, truth, knowledge, virtue and abiding love."

n these letters all these things are to found in abundance together with self elation, wit, romance and an invalu- chronicle of the times.

he correspondence began while w was merely G.B.S., Music Critic of e World" and, to quote him again, street corner socialist." Ellen Terry England's greatest leading lady and ady in her forties. Shaw was 36. The letters which are read by Peggy Ashcroft and Cyril Cusack on this record begin in 1896, four years after the first desultory communications, and they are consecutive until 1902, covering, among other events of significance, Shaw's marriage in 1898 to Charlotte Payne-Townshend. They span, too, the writing of Shaw's first plays and the London production of "Arms And The Man."

Bernard Shaw and Ellen Terry met for the first time on December 16, 1900. At this point the correspondence lapsed and it seems, the spell was broken. But the affection remained. After "Captain Brassbound's Conversion," he never wrote another play for her and in her old age they did not even correspond.

It remains only to remark upon the reading of this unique correspondence for the record . . . The choice of Peggy Ashcroft and Cyril Cusack could hardly have been bettered and, indeed, most of the time one forgets that it is not the protagonists themselves who are speaking.

* * *

**THE HUMAN VOICE. A play by Jean Cocteau, performed by Ingrid Bergman. Philips Caedmon TC 1118.**

Cocteau's one-act drama is a stunning work and ideal for presentation on gramophone record as, even in its original form, it required neither stage nor setting to communicate the desperation of a woman who is alone, speaking on the telephone with her lover. She says much, intimates much and leaves much unsaid as the lover disengages himself from her life, irrevocably.

To quote a French critic at the first performance at the Comedie Francaise, "Had the piece been played in barren Sahara, the dunes would have moved closer, to listen" . . . It would be impossible to imagine a more potent performance than that given here by Ingrid Bergman. The recorded sound is adequate.

### *THE MOST FOOLISH ANIMAL*

**"Homo sapiens,** thinking man, is the only creature who destroys his own species deliberately. War, in a sense of conflict-to-the-death, or group destruction, is entirely a human invention. Animals in the wild state are not so silly . . . One type of animal kills another type of animal for food, and Nature has equipped it to do it—with fang and tusk, talon and claw. But, the more dangerously equipped they are for the killing of other species, the more elaborate are the rituals for avoiding killing each other. That is the lesson which human military powers have still to learn."
**(Professor Ritchie Calder, of Edinburgh University, in a B.B.C. broadcast.)**

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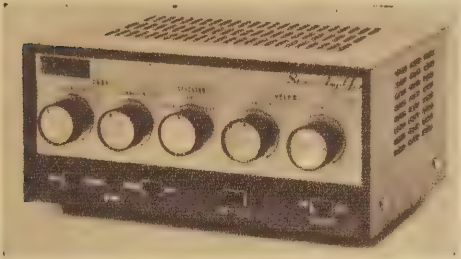

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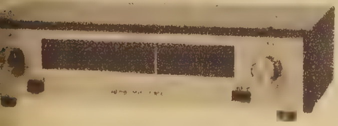

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*See Review in This Issue.*

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P19-E

# VARIETY FARE

"ELECTRONICS Australia"
Staff Review
Panel

## )evotional

**SYMPHONY OF STRINGS. Conducted by Paul Mickelson. Stereo, Supreme SS-2022. Also available in mono SM-1022. (Supreme Productions Ltd., Box 15, Footscray, Vic.)**

Interest: Symphonic arrangements of Gospel favourites
Performance: Lush, yet sincere.
Quality: Outstanding.
Stereo: Full and wide.

Ihe title "A Symphony of Strings" is ar enough indication of the nature of s album but one hardly expects it outdo Mantovani!

The observation is in no way exaggerd, nor is it intended to ridicule either ntovani or Paul Mickelson. It is ply that Paul Mickelson, the noted ngelical musician and conductor, has n provided with a very large and y competent string orchestra, which vides a sound as smooth and lush as thing that ever came from the baton Mantovani or Johnny Douglas. The erence is that the melodies are those favourite Gospel songs, which Paul ckelson has arranged for the occasion: ife Is A Symphony—A Wonderful e—Whispering Hope—Raise Me Jesus Thy Bosom—Sweet Will of God—ar To The Heart of God—Jesus The y Thought of Thee—He Is So cious To Me—We Shall Shine As The rs—If I Gained The World—Jesus Is Sweetest Name I Know—How Great u Art.

Recorded in the Barking Town Hall, London, England, using the technical urces of Pye Record Ltd. and a ps Ampex master recorder, the quality f the highest order. In the stereo sion, which I reviewed, the spread and nition is also excellent.

n album which I can certainly mmend. (W.N.W.)

★ ★ ★

**rld Vision's ENCHANTING Korean Orphan Choir. Directed by Soo Chul Chang. Stereo, Word (Gospel Film Ministry) WST-8340-LP.**

Interest: Children's Choir.
Performance: Unequalled.
Quality: Excellent.
Stereo: Adequate spread.

irected by Dr. Bob Pierce, the World on Organisation, with headquarters J.S.A., accepted, as its initial task, care of children orphaned during the an war. Since then, it has devoted to a variety of other missionary , particularly where distress has pro- a special challenge.

e children in this choir have been ted from World Vision orphanages trained to a high degree of profici-, with a repertoire of over 200 d and secular songs.

is entirely appropriate for me to w from the words, quoted on the t, of Pierre-Petit, professor at the Paris National Conservatory: "When I came to hear the Korean Orphan Choir, I expected to witness a touching Sunday School spectacle, since it concerned 34 Korean children, motherless and fatherless . . . . On the contrary, I was completely won over by the perfection of their execution . . ."

This disc differs somewhat from those reviewed earlier in that it is a mixture of sacred and secular items, though I have no hesitation in classifying it in terms of the former.

Side 1 contains 10 tracks, some of them quite brief, ranging from the simple opening chorus "He Lives" and the Alexander favourite "In The Garden" to Handel's "Hallelujah, Amen" and Malotte's "The Lord's Prayer."

The 6 tracks on side 2 include "Happy Wanderer," "Chiribiribin" and "Finiculi, Finicula," ending with the hymn "We plough the Fields and Scatter."

A charming disc and one that will surprise, for the refinement which has been realised by these young children, singing in a language not their own. Recommended. (W.N.W.)

★ ★ ★

**COMFORT YE MY PEOPLE. The Living Bible—11. Sir Laurence Olivier reads from the Old Testament "The Vision Of Isaiah." Originally recorded for HMV. Released in Australia by the World Record Club. Mono, ALP 1943.**

Interest: Bible readings.
Performance: Stirring.
Quality: Flawless.

This is number 11 out of the set of 12 lavishly produced Bible readings, originally recorded for HMV by Sir Laurence Olivier and presented by Douglas Fairbanks Jr. The selected excerpts from Isaiah, presented in this album, are interspersed by brief stanzas of Jewish music, researched and conducted by Cyril Ornadel.

As with other discs in this series, which I have reviewed, it is impossible to listen to them dispassionately. Verses which one has heard and read a hundred times come vividly to life under the genius of Sir Laurence Olivier.

At the outset, he seems almost too repressed as he enunciates "In the year that King Uzziah died, I saw the Lord . . ." The voice remains quiet as the vision continues "For unto us a child is born . . ." and on to "Comfort ye, comfort ye, my people . . ."

But then comes the challenge: "To whom then will ye liken God?"

The speech rises to a climax which is not just read, but delivered with the sort of fire and passion that must surely have moved Isaiah. This climaxes in the reassuring promise "But they that wait upon the Lord shall renew their strength . . ."

This is, indeed, "Living Bible," an album which should be treasured by adherents of all faiths.

Strongly recommended. (W.N.W.)

**LEAD KINDLY LIGHT. The Texas Boys Choir, direced by George Bragg. Kalman Halasz, organ. Stereo, Festival SDL-931,851. Also available in mono DL-31,851.**

Interest: Boys' choir.
Performance: Polished.
Quality: Good.
Stereo: Modest.

The jacket notes introduce the Texas Boys choir as a group of 26 lads between the ages of 8 and 15. The group is hand-picked each year from a larger group of 150 lads, constituting a choir school based at Fort Worth, Texas.

Founded in 1946 by George Bragg, its present director, and supported by a local citizens' group, the choir has since been featured on 800 major concert appearances throughout the U.S.A., on radio and television and has had notable success in overseas tours.

In the face of such a record it would be foolish to expect other than a polished performance, and polished it is. Yet somehow, it did not evoke the same response from this reviewer as did the Korean orphans' choir, reviewed elsewhere in these columns. The Korean childen are warm, human and with an accent that lends a touch of quaintness; the Texas boys are precise and formal—an atmosphere which is accen-

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# A masterpiece of space-age technology – the fully transistorised ADC "Sixty" Amplifier-22 watts continuous sine wave power per channel

Excerpts from a rave report in Audio (March '66), the leading high-fidelity magazine in the United States: "This is a first class product . . . could only be made with transistors . . . what our instruments and ears reveal is impressive indeed . . . response is VERY wide-band +0, -2 db from 5 c/s to 60,000 c/s, square-wave observations confirm this . . . IM distortion is usually the downfall of transistor amplifier outputs, not so here; there was no characteristic camelback curve, either . . . THOSE ARE THE SPLENDID SPECIFICATIONS THAT WE ARE ABLE TO DERIVE; IT NEED HARDLY BE MENTIONED THAT SOUND IS AS PURE AS YOU WOULD EXPECT IT TO BE . . . we are inclined to guess safely that ADC will sell a lot . . . certainly an auspicious entry into electronics."

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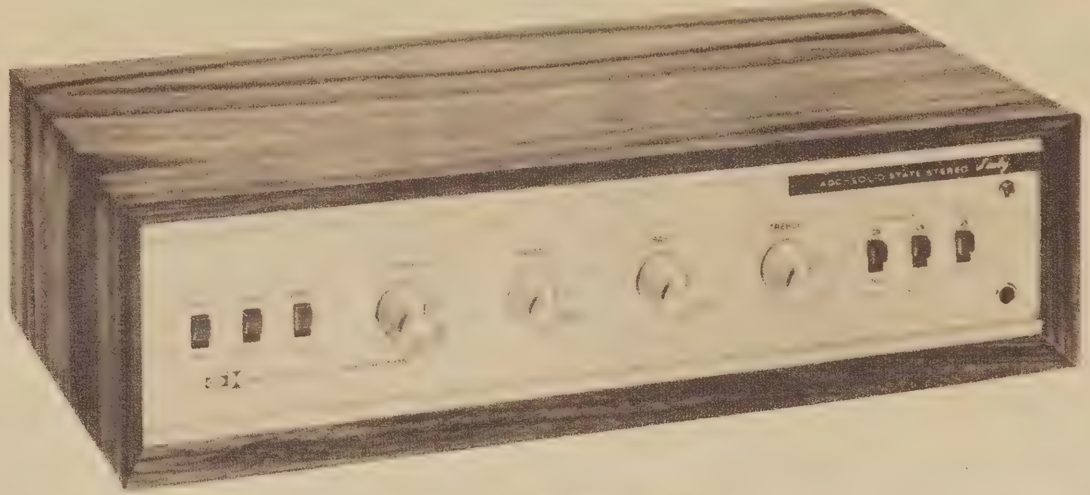

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ated by the equally precise and yet omewhat mechanical accompaniment on very electronic organ.

Apparently but a part of their total epertoire, the boys present here a proram of traditional hymns: Come, Holy pirit—A Mighty Fortress Is Our God -My Country Tis of Thee—Holy, Holy oly—Onward Christian Soldiers—Lead indly Light—Now The Day Is Over— rom Greenland's Icy Mountains—Rock f Ages—He Leadeth Me—Watchman, ell Us Of The Night—Nearer My God, o Thee—Jesus, Lover Of My Soul— lest Be The Tie That Binds—God Of ur Fathers.

This is one you should hear for ourself. (W.N.W.)

## INSTRUMENTAL, VOCAL & HUMOUR

**LIKE TCHAIKOVSKY. Carmen Dragon conducting the Hollywood Bowl Symphony Orchestra and the Capitol Symphony Orchestra. Stereo, Capitol SP-8617. Also available in mono P-8617.**

Interest: Popular Tchaikovsky melodies.
Performance: Entertaining.
Quality: Excellent.
Stereo: Effective.

With its title, its orchestras, its conuctor and the classically inclined beach rl cover design, this album fairly outs its country of origin. But the usic itself comprises straightforward, opular Tchaikovsky selections, which n hardly fail to find a ready and reonsive audience, even two or three of e items are aggravating in their brevy.

The playing itself is clean and fulme with quite massive orchestral und in "Chinese Dance" and "Capccio Italien." The quality is good, the ereo is good and ample reverberation the recording environment lends richss to the sound.

The list of tracks: Polonaise— abian Dance (from "the Nutcracker") Chinese Dance (from "The Nutacker")—Andante Cantabile—Waltz om The Serenade For Strings — omance in F Minor, Op. 5—Melodie om "Souvenir of a Beloved Place") None But The Lonely Heart — Capcio Italien, Finale.

An excellent disc for those who like ppets from the classics. (W.N.W.)

★ ★ ★

**HAT NOW MY LOVE. Herb Alpert and the Tijuana Brass. A and M (Festival) Stereo, SZL-931,968. (Also available in mono.)**

Interest: Popular melodies.
Performance: As good as ever.
Quality: First class.
Stereo: Effective.

One of the most universally liked musi- groups playing today is the Tijuana ass. Their style of playing popular ies seems to have a unique quality ssessed by no other group, a characterc to which the excellent arrangements the musicianship of the performers tribute in no small measure.

The "Brass" sounds as good as ever this latest disc. Herb Alpert uses inly the same recipe as before, with trumpet played by himself taking the ding role, supported by the other brass yers, while the guitars and percussion in with Mariachi rhythms.

However, one is conscious of a different quality in the playing here. The difference is that, for most of this record there is only one trumpet playing, whereas in previous records Herb Alpert has played consistently in close harmony with a second trumpet. Here and there the second trumpet puts in a brief appearance, so buyers will be able to decide which style they prefer.

The stereo is of the "three channel" variety, with Herb Alpert in the centre between two supporting groups. This sounds very effective as long as Herb is playing, but leaves a hole in the middle when he stops. Technically the disc is of the same high quality as the other Tijuana Brass records.

What Now My Love—Freckles—Memories of Madrid—It Was A Good Year—So What's New—Plucky—Magic Trumpet—Cantina Blue—Brasilia—If I Were A Rich Man—Five Minutes More —The Shadow Of Your Smile. (H.A.T.)

★ ★ ★

**MOZART OVERTURES. Otto Klemperer conducting the New Philharmonia Orchestra, the Philharmonia Orchestra. Columbia 12-inch mono, 330CX-1948.**

Interest: As the title says . . .
Performance: Disciplined, but warm.
Recording: Excellent.

A pleasant disc for Mozart lovers, with Dr Klemperer and the two Philharmonias playing overtures from the most popular of his operas: Le Nozze di Figaro, Don Giovanni, Cosi Fan Tutte, La Clemenza di Tito, Die Entfuhrung aus dem Serail and Die Zauberflote. There is also the Adagio and Fugue in C minor, K.546 and the Mauerische Trauermusik, K.477.

As one would expect the playing is strongly disciplined, but far from dry or unsympathetic, Klemperer's insight into the music ensures otherwise, and the music sings with full Mozartian warmth and jollity.

The recording is of excellent quality, with very low noise and distortion and admirable tonal balance.

Extremely pleasant. (J.R.)

★ ★ ★

**HOLLYWOOD BRASS conducted by Jerry Fielding. Ampar (Festival) Stereo SML-931,890. Also available in Mono on ML-31,890.**

Interest: All brass combination.
Performance: Excellent.
Quality: Very good.
Stereo: Normal spread.

There no longer seems to be any doubt about it — BRASS is in. Personally, I find this a pleasant change from the "singing strings" type of presentation, which I never liked very much anyway. So far as I know, nobody has yet coined the term "singing brass," but the term would not be inappropriate in this case. Certainly the smooth, mellow sounds created by the Hollywood Brass on this disc should do much to destroy the image of "blaring brass."

The 12 numbers presented by the group are all popular songs, arranged for purely brass and percussion group. The titles are: King of the Road—Hang On Sloopy — Yesterday — It's Not Unusual — Ka Boom-Boom — Goin' Out of My Head — Downtown — Yeh, Yeh — (I can't Get No) Satisfaction — You'd Better Come Home — Cover Me —Spanish Flea.

I have not previously encountered the Hollywood Brass, and imagine the group has been formed from among the orche-

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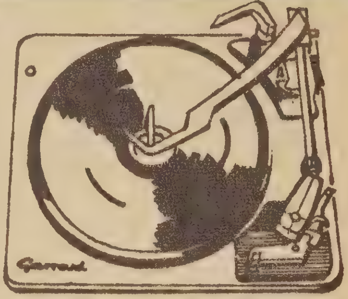

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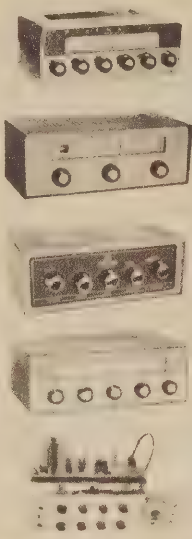

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("R. TV & H." March, 1964)

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## Reader's Digest Album

**ET'S GO LATIN. Fifty Latin-American Favourites for Listening and Dancing. Four-record album. Stereo, Reader's Digest RDS 21-1,2,3,4. Also available in mono.**

Interest: Latin-American melody.
Performance: Topflight.
Quality: Flawless.
Stereo: Distinct separation.

While I am by no means averse the Latin-American sound, I uldn't help wondering how I would el about it after listening through e four LP discs in this new boxed t. I needn't have worried, because eader's Digest have taken good care see that the South American idiom es not weary by over-emphasis— should I say exaggeration.

Perhaps I should stress that, in no nse, is this a study of Latin-Amerin folk music in primitive setting. s the title of the set suggests, it is invitation to enjoy, to listen, to nce to music, played in the modern anner but throbbing with the spirit Latin-America.

And to ensure that it has a claim authenticity, Reader's Digest comissioned RCA to record the albums Mexico, using Mexican orchestras d musicians.

Record 1, side 1 carries six tracks der the general title of "Golden its From Latin America" and, beuse they are golden hits, they are irly familiar. Side 2 carries a colction of bossa novas and sambas der the general title "Rio By oonlight."

Record 2 is devoted to "Dancing In The Latin Manner," taking in a round dozen cha-chas, mambos and rhumbas.

"A Tropical Serenade" is the title for record 3, with its emphasis on more romantic themes.

The same theme carries over to side 1, record 4 "The Romantic Tango," with side 2 devoted to mariachis and marimbas and titled "Down Mexico Way."

Whether or not you're partial to dancing, the music is highly listenable, characterised by widely varied arrangements and playing that is as precise as it is carefree. And, as is usual with these Reader's Digest RCA Dynagroove recordings, the discs are technically above reproach. Every note is clean, right to the inner grooves, the stereo is cleanly defined and there isn't a trace of background noise.

An excellent set if you're at all partial to music from "down Mexico way!" (W.N.W.)

s of the Hollywood film studios. One g is clear from their performances this disc — they are all competent icians. Jerry Fielding's arrangements e for very enjoyable listening, too, all in all this disc should give a d deal of pleasure — provided you all-brass combinations. (H.A.T.)

★ ★ ★

**RBA'S DANCE PARTY. Theo Couloris and his Orchestra. Festival, Stereo SFL-931,989. Also mono on FL-31,989.**

Interest: Greek popular music.
Performance: Bright, exotic.
Quality: Very good.
Stereo: Wide separation.

his playing by a group of Greek onals now domiciled in Sydney will d rather exotic to those used to more conventional style of dance d performance. In some part its ds definitely oriental in character, e the rather unusual orchestral bination of bouzouki (a kind of dolin) accordion, guitar, bass, drums tambourine makes even the more iliar tunes played by the group take an unusual character.

hile this record will no doubt be ived with enthusiasm by the Greek munity, I feel it will have only ed appeal to those of different exion. However, I must add a word t the excellent vocal rendering of ver On Sunday" by Nitsa Almaz. Almaz not only can sing but knows to sing (which is not always the with vocalists) and I am surprised was allowed only one song on the e disc. A few more from her would have made it a much more attractive proposition, to my mind.

The numbers are mainly what are presumably popular Greek songs (whether traditional or modern is not stated) plus a sprinkling of more familiar numbers: Get Up and Dance My Doll—Rambi—Allegro (Seruico)—The Willow Tree—Zorba the Greek—The Wood—Shish Kekab—Calamantianos—Life Without Love—Minore (Seruico)—Never On Sunday—The Little Crabs.

This is a local recording, and Festival have made a good job of it. The sound quality is bright and clean, and the stereo spread is good, though perhaps the channel separation is a bit extreme. (H.A.T.)

★ ★ ★

**VIENNESE WALTZES. The Vienna National Opera Orchestra conducted by Max Schonherr. Festival Records, Stereo SFL-931,846. Also available in mono FL-31,846.**

Interest: Viennese Waltzes.
Performance: Good.
Quality: Good . . . but . . .
Stereo: Normal.

While the music presented on this disc is technically precise, the overall effect is somewhat disappointing; the music simply doesn't have the sparkle which is expected of such great melodies. In fact, the total effect is of a mechanical performance, recorded in a room which is acoustically quite dead. A little reverberation, either natural or electronic, would have brightened the presentation no end.

Apart from this, the music is quite

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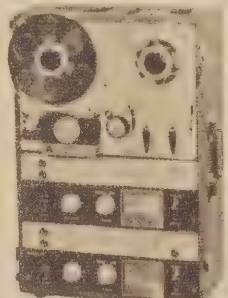

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enjoyable and lovers of the waltz sho
extract much pleasure from the melod
Titles presented on the disc: Tales
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— The Emperor Waltz — Vienna Bl
— Over The Waves — Swallows F
Austria — Sounds From The Sphere
Vienna Bon Bons — On The Beaut
Blue Danube. (K.W.)

* * *

**THE BOY FRIEND—Original Broad
Cast Recording, with Julie Andr
and John Hewer, Paul McGrane
his Bearcats. RCA 12-inch m
LOC-1018.**
Interest: Musical comedy.
Performance: Lively.
Recording: Good.

The original Broadway cast reco
of the Feuer and Martin musical co
of the 1920s period and its music,
Boy Friend. John Hewer and the
rently popular Julie Andrews are the
tured singers, with the music prov
by Paul McGrane and his appropri
named Bearcats. It makes very plea
listening.

The tracks are called—Overtu
Perfect Young Ladies—The Boy F
— Fancy Forgetting — Won't
Charleston With Me—I Could Be H
With You—A Room In Bloomsbu
The You Don't Want To Play With
Blues—Safety In Numbers—The Ri
—It's Never Too Late To Fall In
—Carnival Tango—Poor Little Pier

Although not Dynagroove, the re
ing is quite good. (J.R.)

* * *

**ZORBA THE GREEK and 11
great movie themes—Enoch
and The Light Brigade, with
Severensen, Tony Mottola, Dic
man and Robert Maxwell. U
sal Record Club 12-inch s
SUP-766. (Also in mono, UP**
Interest: Movie themes.
Performance: Usual light touc
Recording: Excellent.
Stereo Quality: Good.

Another disc of movie themes fro
ever-active Enoch Light and his
Brigade, with each theme given a
and appealing new sound select
match its particular mood. It make
enjoyable and entertaining listenin

The tracks are: Zorba the Greek-
of Fools—Forget Domani ("
Rolls-Royce")—Dear Heart—Chim
Cher-ee ("Mary Poppins")—I Rem
Her So Well ("Fanny Hill")—T
("West Side Story")—Exodus—The
ler—Four Horsemen of The Apoc
—King of Kings—Satan Never Sle

The recording is of excellent q
and the stereo wide, although a litt
in the centre. (J.R.).

* * *

**GALA NIGHT AT THE T
Reginald Dixon at the organ.
Columbia Encore Series 330EX-**
Interest: Organ dance-a-long.
Performance: Flowing.
Quality: Good.

In recent months we have had
records from the tireless Reginal
son, played on the huge pipe W
installed in the Tower Ballro
Blackpool, England.

For the most part, these hav
organ recitals, in the "picture
manner, authentic, extremely we
ed and benefiting from high
stereo recording.

This new Encore series relea

## ERENADE . . . "can enthusiastically recommend"

**ERENADE. Leon Symphony Orchestra. Universal Record Club (originally recorded for King Records, Japan). Stereo UP761.**

Interest: Light classics.
Performance: excellent.
Quality: Excellent.
Stereo: Wide and smooth.

Fellow reviewer K. W. remarked in recent review that you should not idge a record by its cover. How ght you were, K. W.! This disc rrived on my desk enclosed in the ıost modest of covers. With this, the npromising title and the fact that it as played by a (to me) unknown apanese orchestra, I expected the orst. I could not have been more rong; the disc is a beauty in every spect. The tunes are excellent, the rchestra is extremely good, the ound superb and the stereo spread ide and smooth.

The pieces are mainly those tunes at everybody knows but cannot put name to. They are usually played y what are euphemistically called ight" orchestras, and in this conxt ,"light" may often be taken as synonymous with second rate. There is certainly nothing second rate in the playing of the Leon Orchestra. Their tone is warm and resonant and their timing immaculate.

In fact, in the whole 40 minutes of playing time, the only cause I could find for criticism was in the arrangement of the Schubert "Serenade," where the omission of a complete stanza put the whole thing out of balance, while the piu mosso section seemed to me to be speeded up too much. But why quibble? For 40 minutes of enjoyable listening I can enthusiastically recommend this disc to those who like a good tune well played.

The titles: Serenade (J. Heykens)—Serenade (Schubert)—Serenade (R. Drigo)—Serenade from "Frasquita" (F. Lehar)—Angel's Serenade (G. Braga)—Donkey Serenade (R. Friml)—La Serenata (F. P. Tosti)—Serenata Rimpianto (E. Toselli)—Serenade from "The Student Prince" (S. Romberg)—Serenata (H. Moszkowsni)—Serenade (C. Gounod).

Now you know why it's called "Serenade." (H.A.T.)

s Reginald Dixon in the role in ch visitors to the Tower Ballroom ld know him best — playing the ic to which they can sing and ce.

lost of it is therefore in dance tempo, t of it reaches back through the s but all of it is well played, well rded and very easy on the ear. Ined are medleys of quicksteps, fox-, waltzes, barn dances, a tango and time seaside saunters."

ut, if your interest in the Wurlitzer s back as far as mine, the number will really make you sit up is the ng Boston selection "Blaze Away." ess my memory is playing tricks, amost note for note, the same ver- which Dickson presented on a 2/6d al-Xonophone in the early thirties. t and his "Teddy Bear's Picnic" e probably the two best known organ rdings of the day.

short, an authentic selection of organ dance-a-long and sing-a-long bers, which should have strong ap- to popular organ enthusiasts and those with nostalgic memories of kpool. (W.N.W.)

* * *

**ASSICAL SOUVENIRS. The Vienna Promenade Orchestra conducted by Hans. Hagen. Festival, Stereo SFL-931,842. Also available in Mono FL-31,842.**

Interest: Light classics.
Performance: Competent.
Quality: Good.
Stereo: Normal spread.

ying to be objective about this type ecord is like trying to be objective t a lump of sugar. If you like sugar, buy sugar. If you like light classics, will appeal to you. Every one of the s on the disc is capable of giving od deal of pleasure; none of them s any great demand on the tech- of the players, so they all sound played.

e orchestra has a solo violin prominently placed which tends to dominate the rest of the players. Perhaps it is for this reason that the rest of the violins seemed to be rather restrained. The general effect is rather thin tone from the violin section. Apart from this, the sound quality is very good, and there is no trace of surface noise.

The titles represent as nice a collection of light classics as one could wish for: Tristesse (Chopin) — Traumerei (Schumann) — Ave Maria (Schubert) — Largo from Xerxes (Handel) — Melodie in F (Rubinstein) — Ave Marie (Bach-Gounod) —Claire de Lune (Debussy) — Humoresque (Dvorak) — Adagio (Nardini)—Menuet (Boccherini) — Hungarian Dance No. 5 (Brahms) — Song of India (Rimsky-Korsakoff).

This list alone should be sufficient inducement to those who like light classics to give this one a try (H.A.T.).

* * *

**HOLIDAY FOR GUITARS. Buddy Merril. Festival Stereo SFL-931,806. Also available in Mono, FL-31,806.**

Interest: Guitar arrangements, modern style.
Performance: Bright and cheerful.
Quality: Very good.
Stereo: Normal spread.

This disc features some competent guitar playing in the modern manner. Buddy Merril seems to have evolved a style of his own rather different from the normal guitar technique. Most modern performers in the popular field playing guitar use it to play chords purely for accompaniment purposes. Buddy Merril plays the melodies, and leaves it to the accompanying band to provide the background and the beat.

Sometimes he plays the tunes straight on the deeper toned strings, but when he ventures to the high end he obviously feels the rather thin tone of the single string needs reinforcement, and adopts a tremolo style, which makes the instrument sound like a mandolin. Unconventional, but effective.

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**N.B. Multiple Speaker Systems** can also be "stage-built" using Axio or 301 as the first stage unit. Full details in the High Fidelity Manual.

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he program includes current and popular melodies with a spicing of t classics. Here is what you get: iday for Guitars—Granada—Take —Michelle—Lover—Sweet September —April in Portugal—Donkey Seren- —Yesterday—Portuguese Washer- nan—Wooden Monkey—Song of a—Iris—Theme from Zorba the ek. (H.A.T.)

* * *

**MAN COULD GET KILLED, the original motion picture score, music composed and conducted by Bert Kaempfert. Festival (Decca, U.S.A.) Stereo SDL-931,948. (Also available in Mono DL-931,948.)**
Interest: Film music.
Performance: Pleasing.
Quality: Excellent.
Stereo: Normal spread.

he film concerned here is one of the ent crop of cloak-and-dagger comedy lers. In this record, the music is n a sparkling performance by an un- ed orchestra of skilled players un- the direction of the composer. While e of the shorter pieces intended to mpany a specific action in the film much of their meaning, there is still od deal of pleasant listening. Still, feels that a lot of the music would on new meaning after the film has n seen, particularly as most of the k titles are puzzling, even meaning- without some knowledge of the mpanying action.

he 12 tracks are entitled: Main —Explosive Welcome, Bi-naveled, Note — Beddy Bye —Beddoes dows—Clues Dropper, A Tape dwich, A Rude Awakening—Noted val—Taking De-tour—Sales Fish— vn to the Docks, A Deadly Game— ed in Oil—Handy Andy, Hail the lea—No A Go-Go (End Title).

ake no mistake about it though, e cryptic titles contain a deal of l music. For example, the now lar "Strangers in the Night" is the n theme of the opening track, and ars in various guises elsewhere. I icularly liked the Iberian character ed into several pieces (the location he film is Portugal) and those with ste for Spanish-style music will find yment in these pieces.

chnically the disc is generally of llent standard, with bright sound, I detected some inner groove dis- on on the louder passages towards centre. The stereo spread is wide even. (H.A.T.)

* * *

**NKS FOR THE MEMORY. Noreen Hennessy at the Lowrey Organ, Mono, Festival FL-31,937.**
Interest: Popular cinema organist.
Performance: Pleasing, but . . .
Quality: Clean, but . . .

t recently, Sydney's Prince Edward tre beautiful" was demolished to way for commercial development e area; with it went the famous re organ that Noreen Hennessy had d for 19 years, during which time ad served an audience estimated at 30 millions and accompanied on some of the world's top enter- s.

this nostalgic performance, she songs from the many top shows ere featured over the years at the Edward:

nks For The Memory—Swinging On A Star—Blue Hawaii—Too-Ra-Loo-Ra-Loo-Ral—To Each His Own—Moon River—My Heart Belongs to Daddy—Golden Earrings—S'Wonderful—Blue Skies—June in January—White Christmas—Buttons And Bows—Hawaiian Wedding Song— All The Way—Beyond The Blue Horizon.

*No wonder he couldn't get Maud to come into the garden! ("TV Times")*

Then why the "buts"?

Firstly, because the numbers are played, in the "Wurtlitzer-pipe" manner on a Lowrey electronic organ—which does proper justice neither to "the memory" nor to the organ.

Secondly, because the pedal bass and lower register is very "loudspeakerish" and, in an effort to balance things up, I found myself backing off the bass control.

At the moment, I understand, heaps of hardware that were once the Prince Edward Wurlitzer are being sorted out and reconditioned by members of Sydney's Theatre Organ Society, preparatory to its being re-installed in the Marrickville Town Hall. When it is installed and working, Noreen Hennessy should be invited to do a new "Thanks For The Memory" — in stereo.

In the meantime, this one will have to do. It's pleasant enough but . . . (W.N.W.)

* * *

**PIANO MAGIC, HOLLYWOOD, George Feyer at the piano. Festival record, Stereo SDL-931,849. Also available in mono DL31,849.**
Interest: Motion Picture themes.
Performance: Excellent.
Quality: Good.
Stereo: Normal.

Themes from recent Hollywood productions and the nimble fingers of George Feyer combine to produce a most enjoyable disc. George Feyer has a reputation as an outstanding pianist-entertainer and the polished performance here certainly upholds it.

The themes on the disc are intended to transport the listener to widely separated places on the globe and George Feyer seeks to portray the character of each in thematic sound. A delightful record which is recommended without reservation.

Titles on the disc are: Mary Poppins Medley — The Sweetheart Tree—Moon

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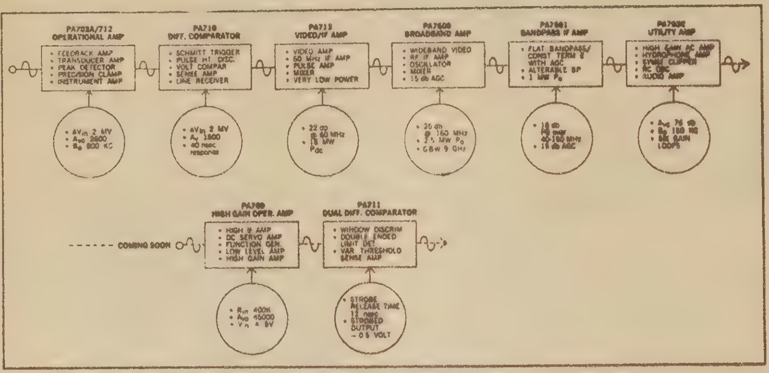

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* * *

**LOS NOCHEROS DE ANTE. Singers. London-Globe (E.M Mono, GLB 1029.**

Interest: Folk songs of America.
Performance: Pleasing.
Quality: Very good.

Los Nocheros de Ante are a grou five young men from Buenos Aires have achieved a measure of fame as singers in their home country of Ar tina and other Latin American count through their radio and TV perf ances. The release of this first recor of their art could well be the first towards international recognition.

They are skilful performers with voice, and the two guitar playing n bers of the group are very compete well. They obviously take great pai the preparation of their songs for formance, with each harmony care formed and each phrase lovingly sh This is very pleasant singing indeed, connoisseurs of folk singing will app ate the excellent renderings as muc

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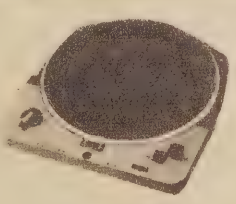

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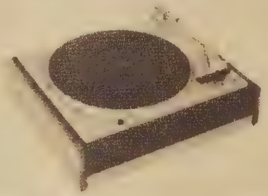
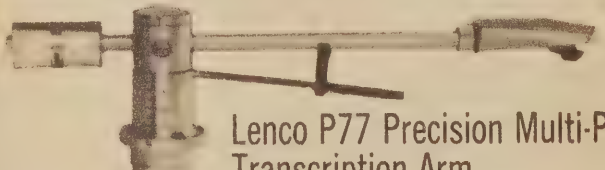


Lenco GL.70 Precision Transcription Unit
Precision engineered GL.70, features an 8 lb. non-ferrous, non-magnetic, diecast dynamically balanced turntable—fully variable speeds—built in "Micro-lift"— pick-up weight adjustment—detachable head shell—and a vertical drive system Wow and flutter is less than 0.2%. Optionally fitted with the latest Pickerin V15/AM1 low mass, high compliance magnetic cartridge. Compliance — 16 10⁻⁶ centimetres per dyne; Channel Separation — 35 db at 1 KC.



Lenco P77 Precision Multi-Plane Transcription Arm

TECHNICAL SPECIFICATION
Overall length of pick-up arm 330 m.m. (13"). Diameter c pedestal 34 m.m. (1.34"). Overall height with screening co 150 m.m. (5.9"). Maximum height adjustment 30 m.m. (1.18" Tracking length (turntable spindle to pedestal spindle) 210 m.n (8.27"). Stylus overhang 17.1 m.m. (0.67"). Maximum adjus ment of Stylus position 10 m.m. (0.39"). Offset angle 23° 12 Tracking error ± 0.8°. Length of cable 1.10 m. (43"). Capaci (plug-in shell to amplifier input) 160 pF. Moment of inertia (wit out cartridge) 148 grs.²/m.m. Low frequency resonance wi cartridge of compliance 5 x 10⁻⁶ cms./dyne — 10 c/s.

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deplore the slipshod performances etimes put on disc.

ne songs themselves will be un- liar to the majority of Australians unfortunately (as is far too often the the sleeve note provides absolutely nformation about the origins of the s. No translation is given for the es and in most cases not even the is translated. This being the case, seems no point in listing the track (H.A.T.).

* * *

**IILY ALBUM. Buddy Williams with Kaye and Harold Williams and the Overlanders. RCA, Mono, L101693.**
Interest: Country and Western Songs.
Performance: Indifferent.
Quality: Good.

nis is a locally recorded disc and performers are all Australian (or at resident here) so it is a pity that best they can offer is a pallid imita- of American Western style singing, ad of a program of Australian rial. The American groups can do sort of thing so much better.

uddy Williams is an experienced per- ner but, in bringing in his young son teenage daughter as co-performers, ems he has allowed parental pride vercome his better judgment. Neither eady for professional entertaining in parts, their performances would considered poor even by amateur lards. The worst feature of the disc e "singing" of Kaye Williams which erky and disjointed and wanders ly off key.

hen the disc was played to a group est their reactions, the pained ex- sions told the story only too plainly. a disc I can recommend, I am id.

oneymoon on a Rocket Ship — I der Where You Are Tonight — Blue Velvet Band — I Fall To es — Missing In Action — Do t You Do Well — By the Silvery nlight Trail — A World of Our — Ole Shep — If I Ever Get Rich n — Talk Back Trembling Lips — nty Miles to Nowhere. (H.A.T.)

* * *

**LASS WITH THE DELICATE AIR. Julie Andrews, music arranged and conducted by Irwin Kostal. RCA stereo LSP-1403, also available in mono LPM-1403.**
Interest: Traditional Airs.
Performance: Light and smooth.
Quality: Good.
Stereo: Normal spread.

seeking a description of the per- iance cuptured on this record one hardly go past the title melody "The With The Delicate Air." This is a description for Julie Andrews ie voice is light and trips from note ote without falter. If any fault can ound with the performance it is the rent use of electronic echo xpand the natural resonance of the r's voice in some of the passages.

he musical arrangement for the melo- featured is excellent and at no time allowed to intrude upon the per- ance of the singer. The bustling igement of "The Floral Dance" will al to many, as also will the quiet tion of the ballad "Where'er You ."

Other melodies featured on this record are: As I Went A-Roaming—London Pride—These Precious Things—Pedro, The Fisherman — Tally-Ho! — If My Songs Were Only Winged—The Lass With The Delicate Air—Canterbury Fair —To A Wild Rose—O The Days Of The Kerry Dancing.

This delightful record is well recommended to those who enjoy the sparkling rendition of traditional British melodies. (K.W.)

* * *

**MOONLIGHT IN MAYO. Bridie Gallagher with accompaniment directed by Stan Butcher. Festival Stereo SFL-931,866. (Also available in Mono FL-31,866.)**
Interest: Irish songs.
Performance: Appealing.
Quality: Very good.
Stereo: Smooth spread.

Birdie Gallagher has been a popular entertainer in her native Ireland for some years. Now, with the present vogue for songs with an Irish flavour, she is becoming known elsewhere as a talented singer of traditional Irish folk songs and more modern ballads.

Although the song from which this disc takes its name has been popular in English-speaking countries for many years, the other songs presented here are less known outside Ireland. However, an experienced entertainer like Miss Gallagher can be relied upon to know what the public wants—in fact, the sleeve note says these are all songs for which she has received repeated requests during her many concerts.

Technically the disc is very good. Just enough echo is used to give life to the sound and the stereo spread is smooth.

The titles: Moonlight in Mayo—Cutting the Corn in Cresslaugh—Heart of Donegal—Noreen Bawn—Johnny Gray—Moon Behind the Hill—Star of Donegal—The Old Wishing Chair—Moonlight on the Shannon River—The Hills of Glenswilly—The Kylemore Pass —I Left Ireland and Mother Because We Were Poor. (H.A.T.)

* * *

**FATHER KEVIN O'CONNOR (the singing priest of the Outback) with the Bob Young Orchestra. ATA Records (Festival), Mono only, ATA-31,969.**
Interest: Folk songs.
Performance: Satisfying.
Quality: Good.

Father O'Connor is already well known as a talented singer of ballads and folk songs, mainly due to his radio and television appearances in Australia and New Zealand. Now he makes his debut as a recording artist, and very good he sounds too. His natural talent is supplemented by a thorough musical training which began in his schooldays and continued during his early priesthood, thanks to the interest of other musicians in the Roman Catholic Church. This disc should give considerable enjoyment to those who like folk songs of the traditional kind—especially those who appreciate the finer points of singing.

Although Australian born, Father O'Connor is of Irish extraction, so not unnaturally more than half of the songs on the disc are of Irish origin. Of the remainder, two are by Australian composer John O'Brien (another Catholic priest, incidentally, whose real name is

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## LUXOR TAPE RECORDERS

Another appointment! Encel Electronics has been appointed Australian Distributor for LUXOR products. A completely new LUXOR tape recorder, the model MP464, will soon be available in all Encel Stereo Centres. Precision built in Sweden, the performance of this new recorder must be heard to be appreciated. Features include: 4 tracks, frequency response of 50-19,000 c/s at 7½ ips, three speeds, many control facilities, accepts up to 7in spools, microphone input sens. is 7 mV for mono or stereo microphones, pick-up sens. is 100 mV, radio input sens. is 50 mV. Write to us for complete specifications and prices.

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A complete range of Fisher amplifiers is available. Write for EMQ's (Encel Mail Quotes) or trade-in valuations on your old equipment.

## MICRO TONE ARMS AND CARTRIDGES NOW IN STOCK!

The Micro MA-77 professional tone arm is fitted with Gimbal mountings and is fully adjustable, precision ball bearings being used throughout. See the "Electronics Australia" review, p. 126, April '66. The Encel Electronics price is most attractive — for the MA-77 and also the other lower priced Micro tone arms available at Encel Stereo Centres.

## ACOUSTECH AMPLIFIERS

Encel Electronics has been appointed Australian Distributor for ACOUSTECH—well known and justifiably famous American amplifiers. The new solid state Acoustech Model V is an integrated stereo amplifier, rated at 45 watts RMS per channel — a power rating which applies right through the extended frequency range. The first two Acoustech shipments were sold out within days of their arrival in Australia. Price of the new Acoustech Model V is expected about **$350 (£175).** Please check with us for specifications and prices.

Celestion

## CELESTION "STUDIO SERIES" SPEAKERS

Both Celestion co-axial 12in models are proving very popular in Australia . . . and the price is more than competitive. The Standard Model CX1512 has a conservatively quoted frequency response of 30-15,000 c/s and is rated at 15 watts RMS. The Deluxe Model CX2012 has a frequency response conservatively quoted at 30-18,000 c/s and is rated at 20 watts RMS. Both models employ pressure type tweeters and feature an electrical cross-over at 4 ks/s. April, 65; and "Hi-Fi News," p. 75, June 65.

### ENCEL PRICES

Standard CX1512 .. .. .. .. .. .. .. .. $39.50
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Cabinet construction details are available on request.

DECCA KELLY

## THE NEW DECCA-KELLY KARDIOID ENCLOSURE

Recently the all new Decca-Kelly Kardioid speaker enclosure was released in the United Kingdom. Featuring a new Model DK1 12in bass unit with a Kelly Mk. II Ribbon Tweeter, the Acoustic Lens is also incorporated to improve HF dispersion. The upper limits of sound reproduction of the new enclosure are in the 35 Kc/s region. Cabinets are in hand finished teak. Write for specifications and prices.

Illustrated below is the M-1007 stereo magn cartridge, shown separated from its mount clip. Frequency response is substantially from 20 c/s to 18 kc/s., varying only 4 Compliance is 4.5 micro-M/dyne and the c ridge tracks from 1.5 to 3 grams. Enquire about Encel prices on the M-1007 and o Micro cartridges. You'll be delighted with Encel prices!

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Encel Electronics Pty. Ltd., has been app Australian Distributors of Film Industries phones. These well known products are su as standard equipment with high recorders such as Vortexion and Ferrogra complete range will soon be available Australian recording enthusiast. The typ Ribbon microphone has a frequency re of 35-13,000 c/s plus or minus 3 db extends considerably higher. A recent says . . . "The Film Industries M8a microphone has a most attractive appe coupled with a performance, which, in respects, can stand comparison with th designs at three of four times its price." to us now for details and EMQ.

## KEF SPEAKERS

The new KEF "Celeste" with the im "Super-tweeter" is now in stock. H formance is considerably improved wit new tweeter. Write for EMQ!

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nsignor Hartigan) and the others are n Scotland and England.

lere is the complete track listing: The le Irish Girl—Joe the Carrier Lad—ling to Me—You'd Better Ask Me—gmalangaloo—Joy of My Heart he Star of County Down—Ho-Re, Ro, My Little Wee Girl—Lewis lal Song—None So Sweet—The Irish nting Car—Kitty My Love—Milking Cows with Mary. (H.A.T.)

★ ★ ★

**TMAN THEME and 11 Bat Songs, composed and conducted by Neal Hefti. RCA Dynagroove, Stereo LSP 3573. Also available in Mono LP 3573.**

Interest: Music for "Batman" TV series.

Performance: Competent.

Quality: Very good.

Stereo: Effectively used.

ne assumes that the "Batman" TV s is intended mainly for the young-ge groups, and presumably this re-l is aimed at the same level. Act-on this assumption, I recruited an audience of young people and played this disc over to them to test their reactions. There was no doubt about the effect on them — they enjoyed every minute of it. Not only that—the adults present also found plenty to amuse them.

Interesting and amusing orchestral effects abound, and the whole thing has a tongue-in-cheek atmosphere which will be lost on the juvenile members of the family, but which the grown-up members will appreciate. A happy disc which will give a lot of amusement if accepted in the spirit intended by the composer.

Track titles are: Batman Theme — Evil Plot to Blow Up Batman — Sewer Lady — The Mafista — Holy Diploma, Batman — Straight A's — Eivol Ekdol, the Albanian Genius — The Batusi — Just a Simple Millionaire — My Fine Feathered Finks — Mr Freeze — Jervis — Batman Chase.

The technical quality is up to the usual high Dynagroove standard, and the stereo spread is effectively used. (H.A.T.)

# POPULAR JAZZ

## Reviewed by GRAEME BELL

**Z PIANO AT ITS GREATEST—Oscar Peterson: Erroll Garner: Art Tatum. R.C.A. Camden, Electronic Stereo CAS-882.**

Interest: Jazz Piano.

Performance: Highly competent.

Quality: Reasonable.

Stereo: Electronically reprocessed.

total of 10 tracks is presented here n very early recordings made by e of the greatest jazz pianists of our , with Peterson using a rhythm sec-, but Garner and Tatum playing

eterson's three examples are taken n early recordings made in Canada I'm afraid that here he runs a bad l in the company of such brilliantly ginative and swinging playing from Garner and Tatum.

atum, the greatest jazz pianist of all with his dazzling embellishments, Garner with his robust dramatics, both jazzy to the core, whereas early efforts of Peterson display a tly corny approach common to ical pianists when they attempt to jazz.

lis is an excellent album, however, should not be missed by those in-ted in piano jazz.

★ ★ ★

**NY GOODMAN. Performance Recordings 1937-1938. M.G.M., Mono. V02-9186.**

Interest: Great Swing Band.

Performance: Tremendous.

Quality: Good for 1937 "live."

is is Volume 1 in the Treasure Series and, when one considers this music was recorded live nearly ears ago, one is startled by the al brilliance and sheer jazz excitement of it all.

This is the great Goodman Orchestra that captured the imagination of the youth of America and caused near riots with its new approach to big band jazz.

In addition to the big band, featuring such greats as Harry James, Gene Krupa, Ziggy Elman, Vido Musso, Jess Stacy, etc., there are four tracks by the Trio and Quartet, featuring pianist Teddy Wilson and vibraphonist Lionel Hampton.

Those of us who grew up with this jazz owe it to ourselves to own this album and, likewise, if the teenagers of today are going to continue to wear the fashions of yesterday, then they owe it to themselves to listen to the popular music of the same period.

Goodman's own clarinet playing defies analysis — like Walter Lindrum, he has had no successor.

★ ★ ★

**THUNDERBALL, THE MAN FROM U.N.C.L.E. and Other Secret Agent Themes. Festival Records, Stereo SFL-931,881.**

Interest: Modern commercial Jazz.

Performance: Studio professionalism.

Quality: Bright.

Stereo: Normal.

Jazz and studio musicians J. J. Johnson, Mundell Lowe, Ernie Royal, Milt Hinton, Joe Newman, Bobby Crowe, Johnny Knapp, Sy Salzberg and Larry Charles play the title themes, and others such as "From Russia With Love," "The Spy Who Came In From The Cold," "The Ipcress File Theme," "I Spy," etc.

A pleasant record of its type, with some very musicianly arrangements of the Henry Mancini type, all excellently recorded. ■

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# TRADE REVIEWS AND RELEASES

## PROFESSIONAL QUALITY TAPE RECORDER

**Magnecord Sales and Service, of 210 Clarence Street, Sydney, have announced the release of a new Akai model X-300 "Cross Field" four-track stereo tape recorder. A unit of professional quality and featuring the cross-field bias system, the X-300 is attractive and businesslike in appearance.**

As indicated by the title, a special feature of this all-transistor tape recorder is the cross-field bias system which is claimed as a developmental breakthrough by Akai Electric. On conventional recorders, the signal and the bias voltages are applied to a common recording head and there is a tendency for the bias field to limit the upper frequencies which can be recorded.

With the cross-field system, the normal record head carries only the signal to be recorded, while a second head introduces the bias. The two heads are mounted facing one another, with their centres slightly off, as illustrated. With the functions thus separated, improved upper frequency response is claimed.

Whatever arguments there may be for and against this bias system, it certainly yields the results claimed for it in this recorder.

In fact, arising from this development, Akai have announced that they are well ahead in their planning for a domestic video tape recorder, with a possible release date quoted of early 1967. It is understood that the video recorder will use the same basic mechanism as this present X-300, but with tape speed raised sufficiently to yield the required frequency response.

For the present, frequency response of the X-300 is quoted as 30 to 24,000Hz at 7½ips and 30 to 18,000Hz at 3¾ips. Measured at a level of —15dB below reference, the figure nominated by the manufacturers, this specification was met. Measurement at 3¾ips showed a figure of —7dB at 30 Hz and—11dB at 18,000 Hz and although this falls short of specification the —3db points were read at 40Hz and 13,000Hz, which is still very good indeed.

As a matter of interest, frequency response measurements were also made at reference level. At 7½ips, the figures obtained were —1dB and —12.5dB at 30Hz and 24,000Hz respectively. At 3¾ips, the figures were —6.5dB and —14dB at 30Hz and 14,000Hz respectively.

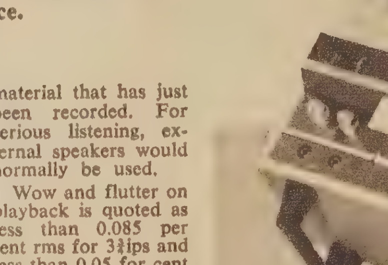
The difference between the figures, measured at reference level, according to the in-built meter, and at a lower level is not unusual with tape recorders and has been mentioned previously in these columns. It is pointed out that, in typical program material, the level of the higher frequencies, at least, is usually well down and it is therefore logical to evaluate recorders on this basis.

The power output per channel of the X-300 is quoted as 25 watts of music power, or 20 watts of undistorted output, which should be ample for all normal requirements.

Two 6in x 4in oval speakers are fitted, one at each end of the cabinet. Although these speakers might not do justice to the full power output from the amplifiers, they are a decided asset for quickly checking material that has just been recorded. For serious listening, external speakers would normally be used.

Wow and flutter on playback is quoted as less than 0.085 per cent rms for 3¾ips and less than 0.05 for cent rms for 7½ips. In the course of making frequency response measurements with constant tones, it was evident that the wow and flutter was not all it might be. Subsequently, actual measurements were made and the figures we obtained were well outside those quoted by the makers.

Over a five-minute check on each of the two speeds, the figures were as follows: At 3¾ips, the wow and flutter varied from somewhat below 0.085 per cent, to a peak of 0.22 per cent RMS. At 7½ips, the range extended from below 0.05 per cent, to a peak of 0.17 per cent RMS. These measurements were taken with the machine in the horizontal position. A check made in the vertical position hinted at a small improvement, but still outside the figures quoted in the handbook.



The slow variation, incidentally, would almost certainly be due to normal creep and stretch in the tape causing the wow and flutter pattern made during recording to fall progressively in and out of phase with that inherent in the mechanism, during playback. DIN specifications, however, require that the recorder be evaluated in terms of the peak of the wow cycle, during a typical record/playback exercise.

In view of the quality of the recorder in other respects, it is reasonable to assume that the particular unit had suffered some impairment in transit and that this order of wow and flutter would be attended to under maker's guarantee.

The X-300 is housed in a solid wooden cabinet, covered with a synthetic material,
slate grey in colour resembling a gra
leather finish. The lid is hinged but the
of hinge allows the lid to be completel
moved for use. The metal work of the
is of aluminium, rather lighter in g
than I would like to see. However,
under no great stress and this point
little consequence.

As implied earlier, the recorder ma
operated in either the horizontal or ve
position. For horizontal use, there are
short legs on the back of the cabinet.
legs nearest the top of the cabine
somewhat longer than the other two.
tilts the unit forward and so gives a
venient operating position. The longe
also serve to wind the power cord a
when the machine is not in use.

The machine is provided with le
vertical operation but it is not inh
stable enough to suggest that it wa
intended to operate free-standing on
stop. Particularly is this so when it
membered that the operate tabs woul
have to be pushed backwards inst
downwards.

The operating switches are of the
type, of generous proportions, which
their use very convenient.

Six other major controls are in th
of small diameter metal knobs. T
positions on the left are each two co
controls. The inner knob controls the
phone level, and the outer the lin
level. In operation, I found these k
be rather "fiddly" to use, with acc
particularly good.

Again, on the model tested, wh
outer knob was turned, the inner on
tendency to rotate as well. This c
most annoying when both inputs we
used but, no doubt, this fault co
remedied easily enough.

The two knobs on the right con
right and left channel volume to
pective speakers. These knobs are no
to operate.

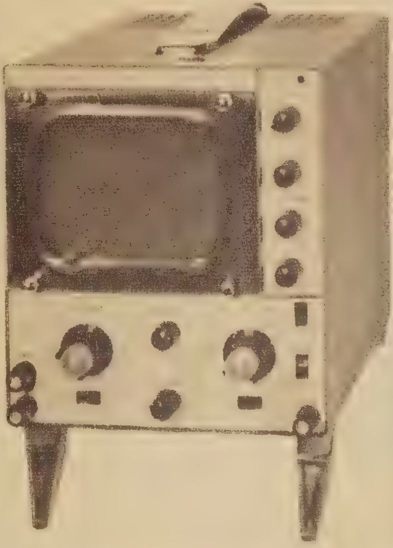
Among the features provided ar
but useful VU meters, inputs and
to line, jacks for 8 to 16-ohm
speakers and a bass-boost button.
is provided for stereo headphones
index counter which is a most use
lity. A tape reel capacity of 10½in
programs of long duration to be
with ease.

A comprehensive and well il
handbook is also included.

At a price of $764.25, the X-3
clearly be classified as a pro
quality recorder. As such,
excellent potential and it is a pity
unit submitted for review came in
ticism on points which would proba
been picked up by normal pre-sale
tion. (I.L.P.)

# GENERAL-PURPOSE 5-in. CRO

he Serviscope S51A oscilloscope is a compact general pur- ose 5-inch instrument designed to provide an attractive ompromise between performance and economy, and is a ecent addition to the well-known range from Telequipment imited, London. This unit pictured was sent for review by the Australian agents, Jacoby Mitchell and Co. Pty. Ltd.



appearance the S51A is virtually 'little brother" of the double-beam instrument reviewed in these nns in the July, 1965, issue. The is finished in attractive pastel wrinkle enamel, with a retracting er carrying handle and plastic the front two feet are provided with props to enable the instrument e tilted for convenient bench-top tion. The front of the case is an rate metal casting with inset print- anels, and the tube face is provid- vith removable plastic hood and l graticule. The useful screen area proximately 4in x 3in.

tube is a 5in flat-faced type and erated at some 3KV overall to pro- a finely focused bright trace. A hosphor is normally supplied, but phosphors are available to order.

e Y amplifier has a maximum sen- ty of 100mV/cM and a bandwidth C to 3MHz (-3dB approx.). A position compensated attenuator re- sensitivity in 1:2:5 steps to a mini- of 50V/cM, which can be re- d further by using external divider es. The input impedance of the uator is 1M shunted by approx.

e sweep generator consists of a r run-down circuit giving six pre- weep speeds from 1uS/cM to 100 cM. A variable control with a of approximately 10:1 provides in- lation, range overlap and reduces slowest available sweep to approx. M. An X gain control permits p magnification of approximately the X amplifier is not available e front panel for external use, but ls may be fed to a terminal at the if the timebase is disabled.

h automatic zero-crossing and ad- ble level triggering are provided, selectable polarity and the choice ther internal or external reference. reliable triggering a minimum of -p is required at the external trig- erminal. A built-in integrator cir- is provided for convenient synchro- on of TV signals at frame fre- y.

operation we found the S51A a performer and one which is most niently used. Although its facili- re a little limited by comparison the larger and more expensive in- ents, it is by no means a "basic" ment, with measuring facilities and ring and bandwidth capabilities g it adequate for much general atory and servicing work.

out the only points which left us y disappointed were (a) the pro- of only six pre-set sweep speeds, b) the omission of a calibration . Presumably these have resulted the drive for economy; yet we r whether the provision of a full sequence of speeds and a simple unclipped) mains-derived signal have increased the cost by very much. These would certainly have made the instrument even more attractive; however it is realised that one must draw the line somewhere, and everyone will inevitably have their own ideas as to just where it should be drawn.

In any case, the S51A must be regarded as a most attractive and compact instrument and one which will make a good account of itself. At the quoted price of $226 plus tax it represents good value for money.

Further enquiries may be addressed to the agents at 469-475 Kent Street, Sydney. (J.R.)

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Allied Capacitors Pty. Ltd., 752 Pittwater Road, Brookvale, N.S.W., are Australian agents for Johnson Matthey and Co. Ltd., of U.K., who have developed techniques for the production of integrated resistance-capacitance circuit systems of novel construction.

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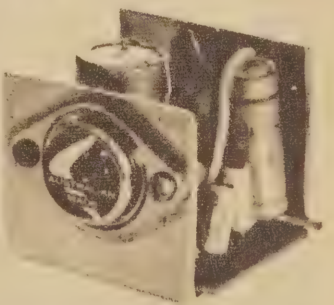

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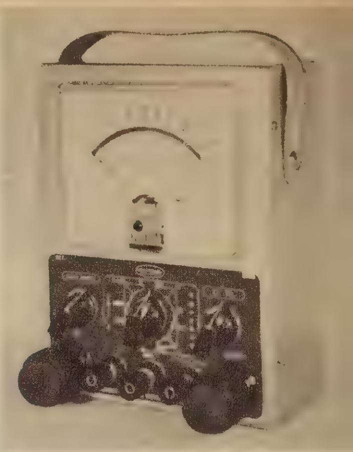

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# TRIO ALL-TRANSISTOR AMPLIFIER TK-400E

**Sent to us for review, direct from the manufacturers, the Trio stereo amplifier model TK-400E is an excellent example of modern solid-state design. With excellent specifications and a performance to match, it is worthy of a place in any hi-fi setup.**

Physically, the amplifier is housed in a bstantial metal case, freely ventilated and ished in two-toned brown and fawn inkle lacquer. The front panel has a tural satin finish; knobs are satin and own to match the colour scheme, with nctions and positions marked in modest pe face. Overall dimensions are 15¼ ches wide, 5½ inches high and 12¼ ches deep.

The overall impression is one of solidity at, as we pointed out in another review st month this presentation more or less ctates that the amplifier be used in a ree-standing" situation, on a table-top or abinet shelf.

With the covers removed, the chassis ructure continues to impress with its neatess and finish, giving the impression of n amplifier that has been carefully designd and well produced.

All operating controls are on the front anel and connectors to all inputs and utputs along the rear apron of the chassis, hich is accessible through the open rear f the metal cabinet.

For clarity, various aspects of the design re set out in the following paragraphs, ach with its own inset heading.

INPUT FACILITIES: These cater for 1 and 2) two separate pickups, one magnetic and the other either magnetic or rystal; (3) direct signal from tape replay ead; (4) "auxiliary," such as tape after reamplification, line, etc.: (5) radio tuner. One function knob allows the type f input to be selected; a second function nob provides the option of stereo, stereo everse, either channel separately or mono, with both channels commoned.

OUTPUT FACILITIES: (1) Stereo loudspeaker systems whose impedance may be anything from 4 to 16 ohms, without need to modify amplifier (polarity marked on terminals); (2) mono signal to feed auxiliary amplifier, centre channel, etc., if required; (3) Stereo headphone jack on front panel with panel rocker switch to silence the loudspeakers; (4) signal output to feed tape system for recording while playing; (5) two mains voltage outlets, one switched, for auxiliary equipment.

SENSITIVITY COMPENSATION. 2mV for magnetic pickups (RIAA compensation), 80mV for crystal pickup; 2mV for tape head, NARTB compensation; 150mV for auxiliary and tuner inputs, uncompensated. On test the sensitivity figures proved to be substantially "spot on," therefore allowing generous output from a typical magnetic pickup, for example, with the gain control less than half-on.

CONTROLS: These include the two function switches already mentioned, volume, balance, bass and treble controls, all continuously variable, together with rotary switch for power off-on and tumbler switches for loudness and compensation off-on, low filter in-out, high filter in-out and loudspeakers off-on. Also included on the panel is a rocker switch to reverse the phase of one channel. The bass and treble knobs and controls are split but friction loaded so that both sections normally rotate together and control both channels simultaneously. However it is possible to rotate the knob sections in different directions so that a simulated stereo effect can be obtained from mono material, with one channel emphasising the bass end and the other the treble end.

FREQUENCY RESPONSE: The measured response between "3dB down" points extended from 35Hz to 25KHz, with the bass control centred and the treble control slightly advanced; this is good, though short of the specifications. Bass control varied the response at 50Hz from +12 to −13dB; treble control varied the response at 10KHz from +10 to −12.5dB; these figures are normal and adequate and, for all practical purposes, correspond with specifications. High filter and low filter cut the response respectively by 11dB at 10KHz and 13dB at 50Hz, both figures being slightly in excess of the specified 10dB.

POWER OUTPUT; DISTORTION: Output is specified as 40 watts music power or 32 watts RMS per channel, for a distortion level approximating 1 per cent; this is stated to reduce to 0.15 per cent at 25 watts, measured at 1KHz. An in-built circuit to protect the output transistors against accidental damage complicates maximum power readings on continuous tone but, without interfering with this circuitry, we were able to verify RMS power figures of 20 watts or better at 50Hz, 23 watts or better at 1KHz and about 30 watts at 10KHz. A surprising aspect of these readings is that they were obtainable at the three frequencies with resistive loads varied between 4 and 16 ohms. At 2KHz, the frequency at which our audio generator output filter happens to operate, distortion was measured as 0.12 per cent at 21 watts into a 16-ohm load.

HUM AND NOISE: Specifications quote −60dB relative to full output, with controls flat, for tape and pickup, and −75dB for tuner and auxiliary inputs. Our measured figure approximated specifications for the tape and pickup inputs but fell somewhat short (71dB) for the other two. In practice, when using the equipment with a typical magnetic pickup, playing at normal room volume, lifting the pickup off the record left a residual noise which could only be heard close up to the speakers.

GENERAL OPERATION: All controls and functions operate very smoothly, and without cause for complaint. The loudness control gives an impressive change in tonal balance at low playing levels; a similar order of bass boost and treble boost could admittedly be set up by the regular controls but the loudness switch has an obvious "lazy man" appeal in that the requisite boost can be obtained without changing the regular bass and treble controls from level.

GENERAL AND CONCLUSION: The amplifier comes complete with an informative booklet containing the full circuit diagram. Distribution and service facilities are available through ACE Radio, 136 Victoria Rd. Marrickville, N.S.W. phone 51-3845. As stated in the introduction, the amplifier is a very attractive unit, well worthy of consideration by anyone setting up a high fidelity stereo system. (W.N.W.)

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# MINIATURE RESISTORS FROM DEITRON

DEITRON IMPORTING COMPANY have available a new line of resistors in ratings of one quarter watt, one eighth watt and one thirty-secondth watt. The resistors are in 10 per cent preferred values and within 5 per cent tolerance. The ¼ watt resistors are available in values from 10 ohms to 500K, the 1/8th watt resistors from 10 ohms to 250K and the 1/32 watt resistors from 10 ohms to 100K. Checked on an accurate bridge, the greatest error found was 3 per cent of marked value; most of the resistors checked were close to 1 per cent tolerance.

The physical size of these resistors may be gathered from the photograph which shows an ordinary dress pin for comparison. The trade name for the resistors is "R.Ohm" and wholesale enquiries would be welcomed by Deitron Importing Company. Retail and trade enquiries should be directed to Deitron Electronics. The postal address for both companies is P.O. Box 86, Broadway, N.S.W. (K.W.)

**FAIRCHILD CAMERA AND INSTRUMENT CORPORATION** has undertaken "the most ambitious plant and facilities expansion" in its history, Board Chairman John Carter told stockholders recently at the firm's annual meeting at the Barbizon-Plaza Hotel, New York. Pointing to new construction in Portland, Maine, Australia, Hong Kong, California, Missouri, Long Island and New Jersey, Mr Carter said that the program was necessitated by "the increasing demand for our products."

Fairchild in Australia are now in two-shift production of transistors and diodes at their new $2 million laboratories at Croydon, Victoria, and will be expanding into the production of integrated circuits by the end of the year.

## *Special Bargains from*
## RADIO HOUSE PTY. LTD.

**"SUNRICH" PORTABLE 5 TRANSISTOR TAPE RECORDER**

**Model 999A $31.50 (£15/15/-)**

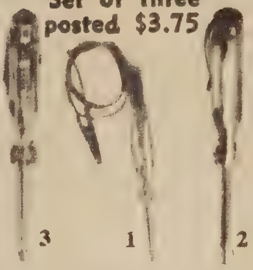
Plus post., 75c.

Reduced from £22/10/

Complete with Tape, Battery, Phone and Mike

### *SPECIAL PURCHASE*

**Set of three posted $3.75**



### CHROME VAN

German screwdriver and pocket tester.

1. 6-12 volt model auto tester.
2. Sparkplug tester.
3. 110-380 Volt mains tester.

**$1.25 each**

# MULTIMETER TESTERS

### Model RH-50

Modern Design, 33 Micro Amp Meter.

30,000 Ohms per Volt D.C.

13,000 Ohms per Volt A.C.

1 p.c. Multipliers and Shunts used. Printed circuit.

Clear Scale, rugged moulded case.

**SPECIFICATIONS**

DC Voltages: 0-0.3-1.2-3-12-30-120-300-600-1,200 V at 30,000 Ohms per volt.

AC Voltages: 0-3-12-30-120-300-600-1,200 V at 13,000 Ohms per volt.

DC Current: 0-.06-6-60-600 mA, 0-12 A.

Resistance: 0-60K-6M-60M (350, 35K, 350K at mid-scale).

Decibels: minus 20 to plus 57 dB (0 dB equals 1 mW. 600 ohms).

Audio Out: Capacitor in series with AC volt ranges.

Short Test: Internal buzzer.

Accessory: 1 pr. heavy test leads.

**Price $31 (£15/10/**

**Postage 50c to $1 extra.**

Batteries: 1 (1.5V), 1 (15V),

Size: 3 5-16" x 6 5-16" x 2

Weight: 1.4lb approx.

### LIMITED STOCK ONLY

### Model RH-10

**RANGES:**

DC Voltages: 0-10-50-500-1,000 V at 2,000 Ohms V.

AC Voltages: 0-10-50-500-1,000 V at 2,000 Ohms V.

DC Current: 0-500uA 0-500 mA.

Resistance: 0-10K-1 Meg: 60 ohms, 6 Kohms at centre scale.

Capacitance: 250uuF to 1uF, in two ranges.

Decibels:—20 to plus 36db, two ranges.

Output; 0-1,000 V in four ranges.

Size: 5in x 3½in x 1½in.

Weight: 13oz approx.

**Price $10.75 (£5/7/6)**

**Postage 50c to $1 extra.**

### Model RH-5

- High sensitivity-20,000 Ohms/V DC, 10,000 Ohms/V AC.
- 3in Meter.
- Handy pocketable size.

**SPECIFICATIONS**

DC Voltages: 0-10-50-250-500-1000 V (20,000 Ohms/V).

AC Voltages: 0-10-50-250-500-1000 V (10,000 Ohms/V).

DC Current: 0-50uA, 0-5-50-500mA.

Resistance: 0-10K, 0-100K, 0-1Meg, 0-10Meg. (62 Ohms, 620 Ohms, 6.2K, 62K at centre scale).

Capacitance: 0.0001uF-0.005uF, 0.05uF-1uF.

Decibels: minus 20db to plus 36db in 2 ranges.

Dimensions: (3½" x 5½" x 1½").

Weight: 15oz approx.

Complete with internal battery, testing leads with prods.

**Price $18 (£9/0/0)**

**Postage 50c to $1 extra.**

### PORTABLE TRANSISTOR TAPE RECORDER

**"SUNACE". PD 401**

**$21.00 (£10/10/-)**

***Postage 75c (7/6)***

Complete with Mike, Battery and Tape.

## *Hearing Aid*

**TRANSISTORISED LATEST DESIGN**

**$32-00 Posted**

### MODEL TP-5 POCKET VOM. TESTER

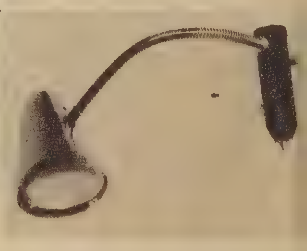
**RANGES:**

- DC Voltage: 2,000 OHMS per VOLT 0-5-25-100-250-1000 Volts.
- AC Voltage: 2,000 OHMS per VOLT 0 - 5 - 25-100-250-1000 Volts.
- DC Current: 0-500uA, 25uA, 500mA.
- Resistance: 0-20K, 0-2Mg, OHMS.
- Capacitance: 500uuF to 0.1uF at 100V AC. 0.01uF to 2uF at 5V AC.
- Decibels: minus 20 DB to plus 48DB in 5 ranges.

**£5-17-6**

**$11.75**

### CAR, CARAVAN LIGHT FITTING



Auto light with switch fits any car, plugs into cigarette lighter socket. 6 or 12 volt available.

**$3.75 Posted**

# RADIO HOUSE PTY. LTD.

**PHONE 26-2817**

**306-308 PITT ST., SYDNEY. Also at 760 George St. and 6 Royal Arcade.**

# FERGUSON RELEASE MATSUNAGA VARIABLE TRANSFORMERS

**Ferguson Transformers Pty. Ltd. announce that they have accepted the Australian agency for the Matsunaga range of variable transformers and slide regulators, and have submitted sample units from the range for review.**

ll units, regardless of size and capacity, auto transformers with a single layer oidally wound core and sliding carbon sh contact, designed to deliver A.C. ages over the range 0-280V, from a V supply. Power ratings range from A to 10KVA. Most of these units are ually operated, but motor driven units remote control are included in the ge. All manually operated units have a brated dial for rough setting of voltage el, with large white figures on black kground for easy reading.

ample units tested on load proved to be y conservatively rated, and showed no ns of overheating when run on full load. test the safety margin, the 50VA unit run for 15 minutes with double the ninal load (100W at 240V) and at the clusion of the test was not even warm. gulation was tested by running a 1KVA t at no load and at full load, and showed ariation of about 1 per cent, which is arded as very good for these relatively xpensive units.

ll units appeared to be very well made m good quality materials, and the refinents fitted indicated that the makers have considerable experience in the manuture of this type of equipment. The owing styles are available:

TAND TYPE. These are free standing, nually operated units, available with ver ratings extending from 50VA (current ing .25A) to 10KVA (42A). The 50VA del submitted for review sells for a dest $9.45 (trade). This neat little device housed in a round metal case about 4in h by 3½in diameter, excluding the stic block on which the terminals are unted and the 1¾in diameter control ob. The case is finished in fawn-coloured mel and slotted for heat dissipation. The trol knob is large enough to grasp comtably, and has a red pointer for setting inst the voltage scale. The four screw minals, of plastic with serrated edges, are easily tightened and loosened with the gers.

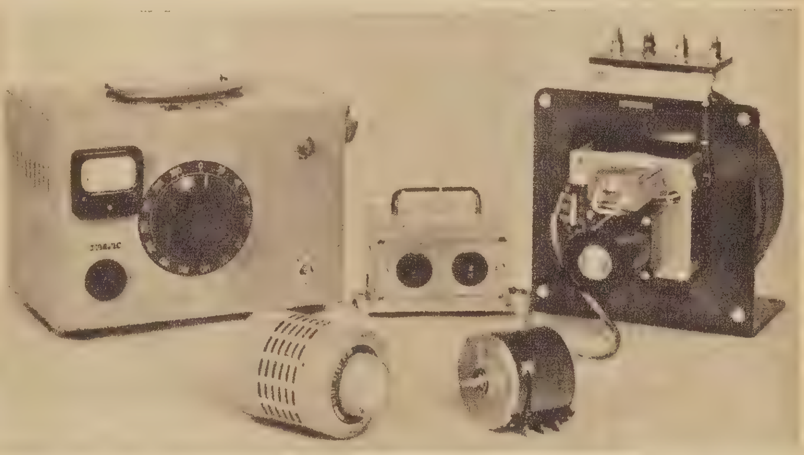
ested against an Avometer, the scale ved to be about 10V out over the full ge on first indications, but by loosening grub screw and slightly changing the ting of the pointer against the scale the duations proved to be accurate enough settings within a volt or two. Regulation s 2 per cent from no load to full load.

PANEL MOUNTING TYPE. The 50VA it was also submitted from this range. ce it was electrically identical to the nding type reviewed above, it was not ted separately. No case or control knob provided, only three terminals are used d nickel-plated nuts are used instead of plastic fittings used on the standing type. view of these obvious economies to the nufacturer, it is rather surprising to find t the trade price of this unit ($9.20) is ly 25c less than the standing model.

PORTABLE TYPE. Three units are availe in this range, with ratings of 500VA 1A), 1KVA (5A) and 2KVA (8.2A). The it examined was the 1KVA model.

This is a completely self-contained iable AC supply requiring only to be nnected to mains by means of the 5ft d and standard three-pin connector suped. It is housed in a neat metal case measuring 10½in wide by 7¼in high by 6¼in deep, excluding projections.

The front panel is furnished with a mains ON/OFF switch, pilot lamp, voltage output control knob with 0-280V calibrated scale, output socket (standard three pin) and output voltage meter. Regulation from no load to full load was about 1 per cent (2.5V over 240V).



*he four variable transformers rom the Matsunaga range described n this review. L. to R., 1KVA ortable model, stand type, panel nounting unit and motorised model.*

This is a very easy and convenient unit to use, and should prove very useful for the service bench and for the experimenter. Price is quoted at $39.05 Trade.

MOTORISED TYPES. These are available as enclosed, panel mounting or stand-type units, with power ratings from 500VA (2.1A) to 10KVA (42A). The main function for these units would appear to be control of lighting levels, particularly in theatres and halls.

The model examined was the P2000 with a power rating of 2KVA and current rating of 8.2A. In this instance, panel mounting refers to the control switch panel, which is designed to be located remotely from the transformer, to which it is connected by three wires.

Push-button switches are used to operate the driver motor, one for each direction of rotation of the slider. The driver motor is of the capacitor run type, and the capacitor gave some cause for concern when it was noticed that it was rated at only 300V AC. However, further investigation showed that this motor is operated from a fixed tapping about midway through the main transformer winding. Inquiries with the suppliers confirmed that the motor operates at about 90V, so the 300V rating of the capacitor is adequate for the purpose.

The complete 320 deg. travel of the slider from minimum to maximum position requires 15 seconds, and we understand this is the same on all models. Limiting switches are fitted at both extremes of travel to prevent the slider over-running. On the model submitted for review, these switches were fixed, so that it was not possible to select a point of maximum voltage below the full 280V. It was thought that this could be a drawback in lighting applications, where the slider might inadvertently be driven beyond the voltage rating of the lamps. However, a terminal has been provided which allows the input to be taken to the extreme of the winding, thus eliminating the step-up facility. Ferguson advise that they expect future models to be fitted with movable switches which can be adjusted to limit the output voltage.

Indication of the care taken in the design of these units is the provision of a cooling fin block on the slider arm behind the carbon brush to prevent overheating of the brush and thereby contributing to longer life.

Also included in the Matsunaga range are miniature and sub-miniature panel mounting types but samples of these have not been seen.

From our study and operation of these units, we concluded that they are well designed, manufactured to high standards and represent excellent value at the prices quoted. (H.A.T.)

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# BULGIN COMPONENTS

**R. H. CUNNINGHAM PTY. LTD.** would like us to remind readers that they are agents for the very wide range of English "Bulgin" electronic components, including many attractive instrument knobs and dials. Of particular interest is the "cursor indicator" pictured, which provides a very neat fixed plastic cursor for disc-type control dials; it is pictured with the K.401/S/D skirted knob dial. The indicator mounts to a control panel with a single hole, and may be obtained with optional in-built indicator lamp. (Having the lamp, it may be of interest to those seeking a neat method of providing illumination for the channel selector dial of a home-built television receiver.) Inquiries for Bulgin products should in the first instance be directed to trade suppliers, who may order from the above firm at 29 Gibbes Street, Chatswood, N.S.W.

# TRADE RELEASES—IN BRIEF

**GENERAL ELECTRIC COMPANY,** in the U.S.A., has entered into a licensing agreement with the Sprague Electric Company under which the latter company will manufacture epoxy-encased transistors developed by GE. Sprague Electric is to acquire technical information, assembly technology and patent licences, as well as production equipment and capability for the manufacture of epoxy encased silicon planar transistors.

As a result of the agreement, Sprague Electric will have a fully mechanised factory with production capacity in excess of a million units a month. The company estimates that the market in the U.S.A. for these transistors will grow from a current level of 100 million units to over 300-million units a year by 1967.

**JFD ELECTRONICS COMPANY,** of U.S.A., will introduce a new series of high-quality disc ceramic trimmer capacitors at the Western Electronic Show and Convention, to be held in Los Angeles from August 23 to 26.

These new capacitors, Standard DVO1 series, are very small units which the makers say have the physical and electrical characteristics necessary for the advanced integrated and hybrid circuits now being designed. Other features claimed are: high volumetric efficiency, great spread between minimum and maximum capacity, high Q and excellent stability.

Eight Delta C ranges are available, i.e., 2-8pF, 2.5-11pF, 3-10pF, 3-15pF, 5.5-18pF, 7-25pF, 8-25pF, and 9-35pF. The capacitance range is covered in 180 degrees, and there is provision for screwdriver adjustment from either side of the capacitor. These units are available with short crimped wiring board leads; flat axial leads with wire holes; flat printed wiring board leads with wire holes; and crimped leads for right-angle mounting on printed wiring boards. The capacitors meet or exceed applicable requirements of Spec. MIL-C-81A.

JFD Electronics are represented in Australia by Ducon Division, Plessey Components Group, Villawood, N.S.W.

**EMERSON AND CUMING INC.,** of Canton, Massachusetts, U.S.A., has sent details of new materials.

ECCOSORB NZ is a series of thin broadband absorbing materials for use in the frequency range from 50MHz to 15GHz. It is a sintered ceramic, and therefore unaffected by high vacuum and resistant to high energy radiation. The material is supplied in the form of tiles. NZ-1 tiles are 2in square by 1in thick with four pyramids. NZ-2 tiles are 1in square by ¼in thick, and are thus suitable for lining curved surfaces.

ECCOCOAT 909c is a flexible coating material designed primarily to weathercoat porous materials such as flexible foam, microwave absorbers or lightweight dielectric materials. The makers say it is transparent to RF and microwave energy when properly applied.

ECCOMOLD HT-50 is an epoxy compression moulding powder with the following features: it can be moulded at pressures below 100psi; it produces moulded items with densities as low as 40lb/cu. ft; it has a heat distortion temperature above 500 degrees F.

Details of these products can be obtained from the Australian agents, Wm. J. McLellan and Co. Pty. Ltd., The Crescent, Kingsgrove, N.S.W.

**AMALGAMATED WIRELESS VAL
CO. PTY. LTD.** have announced ava
bility of the following new products fr
RCA:

Type 2N4074 silicon NPN epitax
planar transistor for high voltage h
current AF-driver amplifier applications
consumer products and industrial equ
ment.

Types 2N4068 and 2N4069 silicon N
transistors, high voltage types, for wi
band amplifiers and relay driver appli
tions in critical industrial equipment.

Types 2N4036 and 2N4037 silicon P
power transistors, general purpose types
military, industrial and commercial appli
tions.

Type 40405 silicon NPN epitaxial pla
transistor for Class-C RF amplifier, dri
and frequency multiplier service in batt
operated communications equipment.

Types 40422, 40423, 40424, 40425, 40
and 40427 silicon NPN high voltage pov
transistors for Class-A, AF power am
fier service in mains operated radi
phonographs and TV receivers.

Type 40404 silicon NPN epitaxial pla
transistor for low-level Class-C RF am
fier and frequency multiplier service
communications equipment.

TA2847, TA2855 and TA2856 (devel
mental types) HF silicon NPN transist
for TV tuner and IF amplifier applicati

TA2783 (developmental type) silic
NPN transistor for TV receiver appli
tions.

TA2844 (developmental type) insula
full-gate field effect transistor for audio
wideband amplifier applications.

TA2401 (developmental type) silic
NPN transistor for UHF TV receivers.

Types 2N3668, 2N3669, 2N3670
2N4103 all-diffused silicon control
rectifiers.

Details of these products are availa
from the AWV head office; postal addr
is Private Mail Bag, Ermington, N.S.W.

INCREDIBLE BARGAINS

RECONDITIONED ROTATORS

"ANTENNA ROTATORS"—Reconditioned and guaranteed. A limited number of slightly used world-famous Channel Master "Automatic" and "Compass" models available at **$30.00.** Each supplied with 100 ft. of connecting cable. Where required for large amateur transmitting rigs, add a Rotator Alignment Bearing **$13.80.**

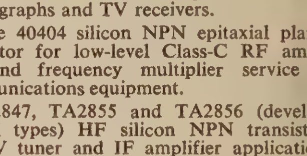
**9047 LIGHTNING ARRESTORS**
to suit 300 ohm ribbon, 66c (6/7).

(£6.18.0)

TV ACCESSORIES, ROTATORS AMPLIFIERS, SUPPRESSORS ETC., BELOW WHOLESALE PRICES . . .

**HCS20 HIGH BAND ADJACENT CHANNEL SUPPRESSOR**

Consists of 2 independently adjustable high Q traps.
Freq. range 100-225 Mc/sec.
Attenuation 1-20 db per trap
Impedance 300 ohm in, 300 ohm out
For effective suppression of either one or both interfering adjacent channels, or can be used as local channel attenuator



**HCS20B, HIGH BAND ADJACENT CHANNEL SUPPRESSOR,** as for HCS20 but impedance 300 ohm in, 75 ohm out.

**LCS20, LOW BAND ADJACENT CHANNEL SUPPRESSOR,** as HCS20 but for low band applications. Freq. range 40-100 Mc/sec.

**EACH, $1.00 (10/-).** Order by code no.

**6103/3/4**
**Attenuator for Channels 3 & 4**
**$1.25 (12/6)**

**AERIAL COUPLING UNITS**

| | | |
|---|---|---|
| 0001 | HI-LO Aerial Coupling Units .. | **$1.50 (15/–)** |
| 0002 | Ch2 Aerial Coupling Units .. | **$1.50 (15/–)** |
| 0004 | Ch4 Aerial Coupling Units .. | **$1.50 (15/–)** |
| 0005 | Ch5 Aerial Coupling Units .. | **$1.50 (15/–)** |
| 0006 | Ch6 Aerial Coupling Units .. | **$1.50 (15/–)** |
| 0007 | Ch7 Aerial Coupling Units .. | **$1.50 (15/–)** |
| 0008 | Ch8 Aerial Coupling Units .. | **$1.50 (15/–)** |
| 0009 | Ch9 Aerial Coupling Units .. | **$1.50 (15/–)** |

Exclusive high efficiency single channel aerial coupling units.

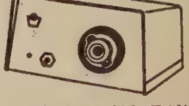
***ALL PRICES INCLUDE SALES TAX. ENCLOSE CHEQUE, MONEY ORDER OR POSTAL ORDER. PLEASE ADD FREIGHT OR POSTAGE***

***WEIGHT WHEN PACKED***

***9047—5 ozs. Suppressors—1¼ lbs. Aerial Coupling Units—13 ozs. Amplifier—6 lbs. 3 ozs. Rotator—15 lbs. Alignment Bearing —2 lbs. Attenuator—2½ ozs.***

**TV FRINGE PRE-AMPLIFIERS**

Vastly improved reception for sets in a low signal or fringe area. The Ferris A.F.B.20TV signal amplifier has its own in-built power supply. Simply stand it on the TV set (any make or age) and operate by a channel selection knob. Particularly effective on older sets. Beautifully designed and constructed.



Aligned for 4 channels. Be sure to specify the channel numbers required. Additional channels **$1.75** each.

**$18.75 (£9/7/6)**

**HURRY WHILE THEY LAST**

***MAIL ORDERS TO:***

**FERRIS BROS. PTY. LTD.**

***752 PITTWATER RD., BROOKVALE. 93-0221***

**'AIRCHILD AUSTRALIA PTY. LTD.**
announced a non-exclusive patent cross-
nsing agreement in the U.S.A. between
rchild Camera and Instrument Corpora-
and Radio Corporation of America.
der the terms of the agreement, RCA
icensed to use Fairchild's planar process
other semi-conductor patents in the
ign and fabrication of semi-conductor
ices, including integrated circuits. The
companies also granted non-exclusive
nces to each other with respect to the
ents of the two firms involving various
ctron valves.

**CORNING GLASS WORKS** has
ounced its entry into the Australian
roelectronics market with the release of
families of integrated circuits. Mono-
ic integrated circuits made by Signetics
rporation, a Corning subsidiary, are now
ilable ex stock in Sydney.

Both series available from Corning are
tal circuits suitable for use in electronic
ruments and displays, computers and
culators and military ground support
ipment.

.U300 series Utilogic has been developed
cially for industrial environments. It com-
es nine circuits, including AND, NOR
OR gates, and a JK binary.

P600 series Diode Transistor Logic is
ived from circuits designed by Signetics
aero-space applications. It comprises six
uits, including gates, buffer, and binary,
sed in a new completely monolithic dual
ine epoxy package.

**TELECOMPONENTS PTY. LTD.,** of
okvale, N.S.W., has commenced delivery
4.5KW three-phase high-tension trans-
ners to Commonwealth Electronics Pty.
. for use in two-channel 1KW linear
plifiers being manufactured for the
partment of Civil Aviation. The trans-
ners were originally designed by
nmonwealth Electronics Pty. Ltd., and
e been manufactured in accordance with
C.A. specifications.

**AUSTRALIAN GENERAL ELECTRIC**
**Y. LTD.,** 103 York Street, Sydney, is
keting a new range of solid state
tching devices.

D13E1 Silicon Bilateral Switch is a silicon
nar multi-junction device having a sym-
rical negative resistance characteristic.
uses a silicon monolithic structure to
ieve a typical switching voltage of 8V
excellently matched characteristics in
h directions. The temperature coefficient
switching voltage is less than .05 per
t/degree C. A gate lead is provided to
access to the zener and PNP base
e.

Operational characteristics are: power dis-
tion 350mW; DC forward current
mA; peak recurrent forward current 1A;
k non-recurrent forward current 5A;
rating junction temperature range —55
+ 150 degrees C; storage temperature
ge —65 to +200 degrees C.

D13D1 is a diode thyristor with electri-
characteristics that closely approximate
se of an "ideal" four layer diode. The
ice uses a silicon monolithic integrated
cture to achieve an 8V switching
age, an ON voltage of 1.75V at 200mA
a temperature coefficient of switching
age of less than .05 per cent/degree C.
gate lead is provided to give access to
circuit between the top of the zener
the base of the PNP.

The D13D1 has a peak reverse voltage
—30V and DC forward current of
mA. Other operational characteristics
as quoted above for the D13E1 device.

14 Series Passivated Rectifiers. These
1.5A glass encapsulated rectifiers for
eral service, featuring transient voltage
ection, which allows the device to dis-
te up to 1000W in the reverse direction
out damage. The available range covers
king peak voltages from 200V to 800V.

iterature containing technical informa-
about these devices is obtainable from
company's head office at the address
wn above.

**AUSTRALIAN ATOMIC ENERGY COMMISSION** will have a display featuring industrial applications of atomic energy at this year's Newcastle Trade Fair, to be held September 7-10. The fair is sponsored by the Newcastle Chamber of Commerce and the Chamber of Manufactures of N.S.W. The object of the fair is to present the whole range of Newcastle's manufacturing, ranging from heavy engineering to light industry and electrical products.

**THE ROLA SPECIAL PRODUCTS DIVISION** of the Plessey Components Group has announced the appointment of Mr R. O. Alexander as Sales Manager of the Division. Mr Alexander is well known in the electrical industry and has had extensive experience in administration, marketing and manufacturing.

**PLESSEY PACIFIC PTY. LTD.** has appointed Air Chief Marshal Sir Frederick Scherger, K.B.E., C.B., D.S.O., A.F.C., a director of the company. Sir Frederick was Chairman, Chief of Staff Committee, Defence Staff, until his retirement, and recently took up his duties as Chairman of Trans-Australia Airlines.

**THE AUSTRALIAN TELEPHONE DEVELOPMENT ASSOCIATION,** representing companies manufacturing and supplying telecommunications equipment in Australia has changed its name to Australian Telecommunications Development Association. The Association is a division of the Chamber of Manufactures of N.S.W. and has a membership of 25 companies, among whom are numbered such important organisations as A.E.I., A.W.A., A.E.T., Ducon, Email, Ericsson, G.E.C. (Aust.), I.R.H., Philips, Siemens, STC, Telephone and Electrical Industries and Telephone Manufacturing Co. (A'sia).

**UNION CARBIDE CORPORATION,** of 270 Park Avenue, New York, U.S.A. 10017, has developed a new automatic temperature regulating device for accurate control of temperature in liquid nitrogen cooled chambers. The unit regulates the flow of liquid nitrogen to maintain required temperatures for a variety of scientific and industrial applications.

*WARBURTON FRANKI LTD., of 307 Kent Street, Sydney, advise availability of a new two-in-one RF directional wattmeter manufactured in U.S.A. by Bird Electronic Corp. The Bird Model 4311 is a portable peak or average (CW) reading directional wattmeter with a frequency range of 0.45-2300MHz and power ranges of 1W to 10KW in the average power mode and 1W to 25KW in the peak pulse or envelope power mode.*

CHANNEL MASTER
pix
see
PICTURE TUBE
GLASS CLEANER

*CHANNEL MASTER PTY. LTD. is marketing a pressure pack glass cleaner developed especially for use on TV picture tube face plates and safety glasses. The trade name of the products is "Pix-See" and trade price for a 15oz can is $1.50 plus 12½ per cent sales tax.*

Weighing only 10lb the controller consists of a rugged, corrosion-resistant control box containing a solenoid valve, pilot lamp, circuitry and regulating equipment, and a thermistor-type temperature probe. The entire unit may be supported by wall, floor or ceiling brackets, depending on operational needs. Specially designed fittings on the control box permit connection of the unit directly to the cryogenic fluid supply line for accurate temperature control. The highly-sensitive temperature probe is mounted inside the cooling vessel.

A simple switch device permits a choice of two wide temperature ranges — a high range, from ambient to —130 degrees F. and a low from —100 to —320 degrees F. If operations call for refrigeration chambers to be opened from time to time, automatic control provides immediate adjustment for as long as the liquid nitrogen supply remains available.

**FERRIS BROS. PTY. LTD.** has added two new models to its range of transistorised portable car radios.

Model M244 is a nine transistor portable (manually tuned) for use as a car radio by locking into an under-dash mounted powered cradle with automatic connection to car battery, aerial and extension speaker. Alternatively, it may be used as a seat mounted car radio operating on its internal dry battery and speaker, using a gutter grip aerial. A safety seat strap and bracket secures the set against sudden braking or sharp cornering. A powered cradle may also be installed in boats or caravans, or any other location where external battery supply is available.

Retail price of the set only is $84.90. Optional extras are: power cradle, $15.90; complete under-dash installation kit, comprising power cradle, extension speaker and top cowl aerial $31; seat mounting installation kit, comprising gutter grip aerial and safety seat bracket with strap, $5.90.

The Ferris Model M254 de luxe is generally similar to the Model M244 but has push-button tuning. Retail price of the set only is $97.90. Prices of accessories are the same as for the M244. ■

# NEW AMERICAN TV POWER BOOSTER UNIT AT LESS THAN HALF PRICE

**$9.75 (£4/17/6) POST FREE**

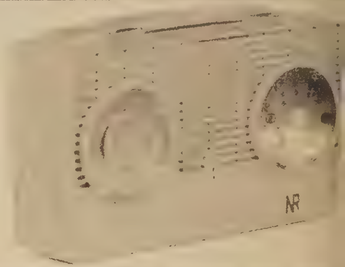
**(EX LIQUIDATION STOCK H. G. PALMER)**

These TV POW-R boosters can be used in two ways. Firstly as a "straight-thru circuit giving extra boost to the TV signal for improved performance on on receiver.

Secondly to boost signal strength to two or three TV receivers coupled to th one aerial.

**Full instructions supplied with each unit. 240 volt A.C. operation.**

## *Complete KIT for* TRANSISTOR 6 PORTABLE $21.95



The complete kit of parts for the transistor six includes six transistors, printed circuit board, coil kit, 4in speaker, Ferguson driver and output transformers, heavy duty battery and all necessary parts to complete the set with full instructions. **Set is housed in attractive plastic case as illustrated.**

Dials available for all States. Post and Pack: extra. N.S.W., $1.00, Inter., $1.30.

## NEW ENGLISH MAZDA TRANSISTORS

| TYPE | EQUIVALENT | | |
|---|---|---|---|
| XA101 | OC45 | R.F. Transistor | 55c |
| XA102 | OC44 | Osc. Transistor | 75c ea. |
| XB103 | OC75 | AUDIO general purpose | 75c |

Ducon type SFT 123 equiv. OC74 .. .. .. 75c ea.
Available in matched pairs at .. .. .. .. .. $1.50 pair
AUDIO OUTPUT
Post and packing on transistors 15c any quantity.

A.W.A. 23" E.H.T. transformers and 23" 110 deg. deflection yokes. New manufacturers stock E.H.T. units $5.00. Deflection yokes $5.00. Post free

## NEW VALVES AT BARGAIN PRICES

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1A7GT | 95c | 3S4 | $1.00 | 6J5 | 75c | 6SN7GT | 95c | 1L56 | 95c |
| 1C7G | 30c | 5Y3GT | $1.25 | 6K7G | 45c | 6SS equiv. 6SK7. | 85c | 12A6 | 80c |
| 1D8GT | 95c | 5V4G | $1.00 | 6K8G | 68c | 6U7G | 45c | 12SK7 | 50c |
| 1K5G | 40c | 6B8 | $1.00 | 6Q7G equiv. 6B6G | $1.00 | 6X5GT | 75c | 12SK8 | 80c |
| 1K7G | 49c | 6C8G | 80c | 6SA7GT | 95c | 7C7 | 35c | 12SH7 | 80c |
| 1M5G | 40c | 6F6 | $1.00 | 6SH7 | 85c | 12AU7 | $1.00 | 866 | 1.50 |
| 1P5G | 25c | 6H6 | 35c | 6SJ7 | 95s | 12AT7 | $1.00 | 954 | 25c |
| 1Q5G | 25c | | | | | | | 955 | 25c |
| 1T4 | 45c | | | | | | | 7193 | 25c |
| 3Q4 | 75c | | | | | | | EK32 | 68c |
| EF50 | 45c | | | | | | | EL33 | $1.00 |

**Please add postage on all valves.**

## NEW 4-SPEED STEREO & MONO PLAYERS

### AT LESS THAN HALF PRICE

**PHILIPS 4-SPEED**
**6V BATTERY PLAYER**
**MONO $9.75**
**STEREO $11.75**

Post and Packing, N.S.W., 75c.
Post and Packing, Inter., $1.25 Extra.

## NEW 240V. ELECTRIC MOTORS

3300 R.P.M. can be supplied with or without 4-speed reduction mechanism. Size 3¼" x 2¾ x 3½, including spindle.

**$2.75**

## NEW PORTABLE RECORD PLAYER CASES TO SUIT THE ABOVE TURNTABLE

Attractive two-tone cabinet with plastic trim.
Supplied with 5in x 7in speaker in felt-lined enclosure
Space for amplifier and batteries or power supply.

**$11.50**

Dimensions: 15in x 13in x 7in.
Post and Packing: N.S.W., 90c; Interstate, $1.20.

## NEW MULTIMETER—$5.25

POST EXTRA
METER 0-1MA 1,000 OHMS PER VOLT
A.C. RANGES D.C. RANGES CURRENT
SUPPLIED COMPLETE WITH TEST LEAD
RANGE 0-100,000 OHMS

| | | | |
|---|---|---|---|
| 0—10v | 0—100v | 0—500v | 0—500MA |
| 0—50v | 0—10v | 0—1000v | |
| 0—250v | 0—50v | 0—1MA | |
| 0—500v | 0—250v | 0—100MA | |

## EXTENSION SPEAKERS

New 9 x 6 speakers in case.
Post: Interstate, 55c; N.S.W. 40c.

## NEW POWER TRANSFORMERS

60mA prim.: 240v with 230v tapping Sec. 285 x 285 with 6.3v filament winding. 60mA, $2.50. Plus Postage: N.S.W., 35c; Interstate, 52c.

Prim.: 240v, Sec. 385 x 385 at 80mA, fil. 6.3 and 5v, $2.75. Post.: N.S.W., 40c; Interstate, 75c.

60mA H.T. Chokes, 75c. Post.: 20c.

## T.M.K. MULTIMETERS

Before buying see our range of T.M.K. test instruments. As advertised in April issue of Electronics Australia.

## NEW MIDGET POWER TRANS

40mA prim., 240v. Sec 225 x 225 with 6. Fil. Winding.

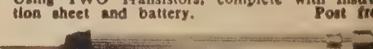
**$2.75** Postage: N.S.W.., 25c; Interstate 45c.

30mA 240v Prim. 150 x 150v. Sec. with 6. Fil. Winding.

**$2.75** Postage: N.S.W., 25c. Interstate 35c.

## TRANSISTORISED SIGNAL INJECTOR, $5.

A MUST FOR QUICK TROUBLE SHOOTI
Using TWO Transistors, complete with instru tion sheet and battery. Post fr



# NATIONAL RADIO SUPPLIES

**332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE 56-7398.**

# RESISTORS, CONDENSERS AND POTENTIOMETERS

**Ve have purchased the resistor and condenser stock of manufacturers including S.T.C. and Stromberg-Carlson vho have ceased the manufacture of television and radio receivers and can offer same at less than 25 per cent f list price.**

'he resistors are mainly I.R.C. and Morganite in values from 200 ohm. to 5 meg. in ½, 1 and 2 watt ratings nd include some wire wound resistors. List price, $9.00 per 100. **Our price, $2.00 per 100.** Post and packing 25c extra.

'he condensers are in most popular makes and include mica, ceramic, paper and electrolytic in standard values. ,ist price, $11 per 100. **Our price, $2.06 per 100.** Post and packing, 35c extra.

'he potentiometers are all current types and include switch pots, dual concentric and T.A.B. pots. ,ist price, $12 per dozen. **Our price, $2.50 per dozen.** Post and packing, 25c extra.

**FREE** For a limited period with each lot of resistors, condensers or potentiometers purchased we will supply free: One New Valve Type 6U7G, 6X5GT or IT4 as advertised on this page.

## nported National Transistorised Shoulder Megaphone

ese shoulder megaphones manufactured by National Radio Japan have an put of 4 watts, and are supplied complete with inbuilt horn type speaker, teries and microphone. List price $78.

**Special Price $50. Post extra.**

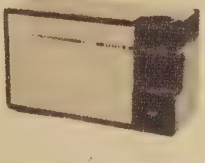
**Other types also available.**

## NEW AMERICAN TWIN TELESCOPE TV AERIAL

Extends to 36in each section can be used singly for car or portable .. .. .. .. **$1.50**

Post 20c.

## NEW 4" XTENSION SPEAKERS



**ese 4" speakers are mounted in lished cabinets suitable for use intercom. units or extension eakers.**

**ST PRICE .. .. .. .. .. $12.**

**ECIAL PURCHASE ENABLES TO SELL THESE UNITS AT . Post and packing, N.S.W., :. Interstate, 98c.**

## NEW GARRARD RECORD CHANGERS

**These New English Garrard Changers with High Fidelity Crystal Pick-ups and Sapphire Styli have just been superseded. We are selling some at LESS THAN HALF PRICE. Available in STEREO at $25.50. POST AND PACKING EXTRA, N.S.W., $1.80; QLD., VIC., TAS., $2.25; W.A., S.A., $1.30.**

## USED HIGH-SPEED 240V. AC/DC MOTORS

**These 240 v. a.c. or d.c. motors are 1/8 H.P. with a speed of 7,000 R.P.M. and are ideal for small drills, grinders, etc. Dimensions, 5½in x 3½in, with 5/16in spindle .. .. .. .. .. .. .. .. $3.75**

**Post, N.S.W., 50c; Interstate, 85c.**

**W 4-SPEED STEREO AYER F.O.R. .. $17.50 (£8/15/)**

**NEW STEREO CHANGER. 4-SPEED F.O.R. .. $21.50 (£10/15/)**

**SLIDER-SWITCHES**
**10 pole 2-way silver plated contacts 38c**

## TYGAN AND SARLON SPEAKER GRILLE FABRIC

**wide. List price $6 per yard. To clear at $4 per yard.**
**Postage and packing, N.S.W., 35c; Interstate 45c.**

## LEADER SIGNAL GENERATOR LSG11

**240V A.C. operated, 6 band 120KC to 390 Mess Provision for crystal.**
**Post N.S.W., 75c; Interstate, $1.25. $29.50**

## BATTERY CHARGER RECTIFIERS

**ew Selenium Rectifiers, 6 or 12 volt, at 4 amp., $3.75. Post, N.S.W., 20c; terstate, 20c, Transformer for above rectifier tapped for 6 to 12 volt, with rcuit for charger, $4.75. Post, N.S.W., 75c; interstate $1.00. above, 6 or 12 volt, at 2a mp., $2.75 Post, N.S.W., 35c; interstate, 45c. Transrmer for above, $3.75. Post, N.S.W., 35c; Interstate, 45c.**

## NEW 240V. A.C. MOTORS

**These small motors, size 5in x 3in x 3½in, are 1-12 h.p., but are only suitable for intermittent use. $2.95. Post N.S.W. 35c; Interstate 50c.**

## THE NEW COLLARO 3-SPEED TAPE-DECKS 2 & 4 TRACK

The ideal deck for the home constructor, as amplifier and all controls can be mounted on deck.

**3-speed 1⅞, 3¾, 7½. ● Pause control. ● Takes 7in. spools. implified controls, 4 Track, $48; 2 Track, $44. OSC Coils, $1.50**

## NEW B.S.R. TAPE DECKS

**These new 3-speed B.S.R. Decks are fitted with a digital counter and will take 7in spools.**
**2 Track, $35.50, 4 Track 45.25.**

## NEW "TECH" V.T.V.M. MODEL TE65

23 RANGES. 240V. A.C. powered.

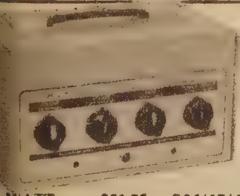
D.C.V. 1.5, 15, 50, 150, 500, 1,500
A.C.V. 1.5, 15, 50, 150, 500, 1,500.
D.B. —10db to +60db.
Resistance. 1 ohm to 1,000 megohm.

**$42.50 POST $1.00**

## A PREAMP FOR MAGNETIC PICK-UP OR TAPE HEADS

***SUITABLE FOR USE WITH THE COLLARO OR B.S.R. TAPE DECKS***

Ising 3 silicon transistors as featured in October. Electronics Australia complete with kit of arts including transistors mono **$7.50**, stereo **$13.00**, 240 power supply for above **$7.00.**



## NEW 17 & 25 WATT P.A. AMPLIFIERS

**WATT .. $53.75, £26/17/6**
**WATT .. $43.75, £21/17/6**
Post Extra on 15 Watt
I.S.W., 10/; Interstate, 15/.
25 Watt by Rail or Air.
Too Heavy, for Post.

**The 25 Watt Amplifier uses 5 valves plus 2 rectifiers including two EF86 low noise valves as microphone preamplifier and two EL34 valves Ferguson push-pull output.**

**All amplifiers are fitted with Ferguson output transformers with voice coil tappings of 2 to 15 ohms.**

**The 25 watt amplifier can be supplied with line output transformer tapped from 100 to 600 ohms if required at 20/extra.**

**Inputs provided for microphone, pick-up, and radio with mixing facilities and tone control.**

**The 15 watt is as above but using two 6BQ5 valves in push-pull output.**

| | | |
|---|---|---|
| **12in speaker for above (10 watt) .. .. .. .. .. .. .. .. .. .. ..** | **$6.75** | **.. 67/6** |
| **Crystal Microphones for amplifier .. .. .. .. .. .. .. .. .. .. ..** | **$4.75** | **.. 47/6** |

# NATIONAL RADIO SUPPLIES

**332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE 56-7398.**

# A. C. E.

AMPLIFICATION

COMMUNICATION

ELECTRONICS

★★★★★★★★★★★★★★★★★★★★ PHONE 51-38

# RADIO

136 VICTORIA ROAD, MARRICKVILLE, SYDNEY,
AND 636 KING STREET, NEWTOWN—51-7008

EVENINGS and WEEKENDS: "KALUA," Hilma Street, Collaroy Plateau, XW59
DULWICH HILL, EARLWOOD, BUS STOPS AT DOOR, STOP No. 42

NEW

## HOME LIGHT BATTERY

CLYDE OR DUNLOP
19 Plate. 150 Amp.
Dry Charged. Cells.

**$3.25 £1/12/6 ea.**

## A.C. D.C. MOTORS

32V and 110V.
High Speed, Series Wound.
1/8 h.p. motors.

**$3.75 £1/17/6**

Post N.S.W. 75c, Interstate $1.25.

## NEW VALVES

| | | | |
|---|---|---|---|
| 1A3 | 75c | 12SK7 | 50c |
| 1A5 | 75c | 12SL7 | $1.25 |
| 1C5 | 75c | 47 | $1.25 |
| 1C6 | $1.25 | 76 | 75c |
| 1C7 | 50c | 84/624 | $1.25 |
| 1D5 | 55c | 723A | $6.00 |
| 1F5 | $1.00 | 807 | $2.00 |
| 1G4 | 75c | 809 | $1.75 |
| 1H5 | 75c | 813 | $7.00 |
| 1H4 | 75c | 829B and Socket | $5.75 |
| 1J6 | $1.25 | 866A | $1.50 |
| 1K7 | 50c | 954 | 50c |
| 1L4 | 50c | 956 | 50c |
| 1M5 | 50c | 1603 | 50c |
| 1N5 | 75c | 1616 | 50c |
| 1Q5 | 50c | 1619 | $2.00 |
| 1T4 | $1.00 | 1629 | 50c |
| 6AR6 | $1.25 | 1050 | $2.00 |
| 6AS7 | $2.00 | 9006 | 50c |
| 6B6 | 75c | AV11 | 25c |
| 6B8 | 75c | CA19 | $10.50 |
| 6BF6 | $1.00 | CK1013 | $1.50 |
| 6BL8 | 75c | CV63 | 75c |
| 6BM8 | 75c | CV66 | 75c |
| 6C8 | 75c | CV1102 | 75c |
| 6F6 | $1.00 | CV1133 | 75c |
| 6G6 | 75c | CV1136 | 75c |
| 6G8 | $1.50 | EBC33 | 75c |
| 6J6 | $1.00 | EC70 | 40c |
| 6J7G | 75c | ECH33 | $1.50 |
| 6J8 | $1.75 | EF36 | 75c |
| 6K6 | 75c | EF37 | 75c |
| 6K7 | 50c | EF39 | 75c |
| 6N7 | 75c | EF72 | 40c |
| 6SA7 Metal | 75c | EF73 | 40c |
| 6SC7 | $1.00 | EK32 | $1.50 |
| 6SH7 | 40c | EL91 | $1.00 |
| 6SJ7 | 95c | EM35 | 75c |
| 6SK7 | $1.25 | KTW62/6U7 | 75c |
| 6SN7 | 75c | RL27 | $1.50 |
| 6SS7 | $1.25 | VR65 | 50c |
| 6X5 | 75c | VR75/30 | $1.50 |
| 7C5 | 50c | VR105/30 | $1.50 |
| 7N7 | 75c | VR150/30 | $1.50 |
| 7W7 | 50c | VT502 | $1.25 |
| 12A6 | 50c | 32 | $1.00 |
| 12AT7 | $1.00 | 42 | $1.00 |
| 12BE6 | $1.00 | 45 | $1.00 |
| 12BH7 | 75c | 37 | $1.00 |
| 12C8 | $1.25 | 49 | $1.00 |
| 12SJ7 | $1.25 | 53 | $1.00 |
| 2A3 | $2.00 | 59 | $1.25 |
| 2C26 | 75c | 89 | $1.00 |
| 2X2-879 | 50c | 77 | $1.00 |
| 3A4 | $1.25 | CL4 | $1.25 |
| 3B7 | $1.00 | EM1 | $1.25 |
| 3D6 | $1.00 | TZ40 | $1.00 |
| 5X4 | 50c | 6AB7 | 75c |
| 5Y4 | 50c | 6C6 | $1.25 |
| 5Z4 | $1.00 | 6SC7 | 75c |
| 6AC7 | 75c | 7A6 | 75c |
| 6AG5 | 95c | 9006 | 50c |
| 6AG7 | $1.00 | | |
| 6AJ5 | 50c | | |
| 6AK5 | $1.00 | | |
| 6AL5 | 75c | | |
| 6AM5 | 75c | | |
| 6AM6 | 75c | | |
| 6AN5 | $1.25 | | |

## GENEMOTORS

| Input | Output | | | |
|---|---|---|---|---|
| 12v | 600v | 300mA | New | $11.00 |
| 12v | 500v | 350mA | | $17.00 |
| 12v | 1200v | 200mA | | $13.00 |
| 24v | 250v | 100mA | New | $4.00 |
| 24v | 540v | 200mA | New | $4.00 |
| 24v | 300v | 250mA | New | $5.50 |
| 12v | 275v | 110mA | | $7.50 |

## CHASSIS PUNCHES

SIZES 5/8", 3/4", 7/8", 1".
1 1/8" with tapered
Reamer and Carry Box.

**$5.75 £2/17/6**

Post 50c, Interstate $1.00.

## NEW POWER TRANSFORMERS

| | |
|---|---|
| 1960 5in CRO | $11.75 |
| 325 x 325 150MA | $9.50 |
| 285 x 285 300 MA | $14.70 |
| 800V and 270V 300MA | $15.00 |
| 240V-110V 1.3KVA Auto | $21.00 |
| 150 x 150V 30 MA | $2.75 |
| 225 x 225V 40 MA | $3.00 |
| 124V Doubler 300MA | $6.75 |
| 130V Doubler 400 MA | $7.75 |
| 145V Doubler 450 MA | $9.75 |
| 150V Doubler 500 MA | $10.75 |
| 220V Doubler 600 MA | $14.70 |
| 310 x 310 170 MA | $4.95 |

## 3" SELSYN MOTORS—TRANSMITTERS

50 V AC — 50 cps.

**$5.75 £2/17/6**

Post 75c, Interstate $1.00.

## RELAYS

| | |
|---|---|
| 6V, 3-pole Miniature | $1.50 |
| 12 volts, DPDT, 5 amp | $2.00 |
| 12 volts DPDT | $1.25 |
| 100pf TX var. condensers | $1.00 |
| Hi-speed Polarised relay | $5.00 |

## PMG TYPE 3000

2000 ohms, $1.25
1000 ohms, $1.25

| | |
|---|---|
| Lapel Crystal Mikes | $1.25 |
| C ystal Mikes with switch | $1.50 |
| Telephone Pick-up Units | $1.25 |
| Contact Pick-up Units | $1.50 |
| 100UA Stereo Bal Meters | $3.50 |

## OIL FILLED CONDENSERS

| | |
|---|---|
| .5mfd 600V | 35c |
| 2mfd 600V | 65c |
| 1mfd 600V | 65c |
| 4mfd 600V | 65c |
| 4mfd 2.5K | $3.00 |
| 1mfd 3000V | $1.70 |
| .5mfd 5K, .1 5K, .1 3K AC<br>.25 4K, .5 2½K ea. | $1.50 |
| 4mfd 3000V | $3.50 |
| 2mfd 3000V | $2.50 |
| 1mfd 3000V | $2.00 |
| 1.25 mfd. 6000v. | $4.50 |
| mfd. 4000v | $3.00 |
| 2 mfd. 2000v | $1.50 |
| 4 mfd. 1500v. | $1.50 |
| 1 mfd. 1500v. | $1.00 |
| 8 mfd. 600v. | $1.00 |
| 1 mfd. 1000v. | $1.00 |

## PYE REPORTER

2-way Vehicle Band Transceivers.
Ex-Taxi Cabs.
12 volt, 70 meg. Complete with valves and speaker.

**$33.75 £16/17/6**

## NEW C.R.O. TUBES

| | |
|---|---|
| 3API-906 3in | $2.75 |
| CV112 5in | $2.00 |
| VCR97 6in | $3.75 |
| ACR10/VCR139A 3in | $3.00 |
| CV1522 1¾in | $2.25 |

## 6" INDICATOR UNITS

TYPE 1A
Suitable for C.R.O. conversion.
Circuit supplied.

**$20.75 £10/7/6**

## NEW 3-GANG CONDENSERS

300 PF+ 200 PF+ 60 PF

**75c 7/6**

## NEW HEADPHONES

| | |
|---|---|
| 5 Ohm | $2.25 |
| 2000 Ohm | $2.25 |
| 4000 Ohm | $2.50 |
| American Lightweight | $1.25 |
| Australian DLR | $1.25 |
| Dynamig Earpieces, pr. | 45c |

Post 25c pr.

## NEW STAND LAMP

18" Goose neck complete with shade. 3-core flex, plug and switch. Ideal for machine light, music light, reading lamp, table or TV light.

**$1.05**

Less shade 75c. Pack. and post., N.S.W., 75c; interstate $1.05.

## WANTED

Communications Receivers. Test equipment. P.A. Gear. Large or small surplus stock. Best prices. Call, write or phone, any time.

## TRANSISTORS

| | |
|---|---|
| 2N174 | $5.00 |
| 2N442 | $4.50 |
| 2N441 | $4.00 |

High-powered units for 75-watt audio, 200-watt power units or transistor ignition.

## NEW VALVE SPECIAL

In lots of 50 only.
5Y4. 5X4, 1616. 6K7.
$15.00 plus Freight.

60ft. extension speaker leads with miniature plugs or suit indoor aerial wire.

35c. Post 5c.

## NEW G.M.F.

1/8 H.P. 240V-A.C. Motors.
2 speed. Reversible.
Capacitor Start.
Double ended drive.
Ball bearings.

**$5.50 £2/15/-**

## NEW METERS

Square. Clear Plastic.

| | |
|---|---|
| 2¼in 50 UA | $4.75 |
| 3⅜in 50 UA | $5.75 |
| 2¼in V.U. Meters | $4.75 |
| 3⅜in 1mA | 4.75 |
| 2¼in 500V. A.C. | $4.25 |
| 2¼in 500V. D.C. | $3.50 |
| 3⅜in 500V. A.C. | $5.75 |
| 3⅜in 500V. D.C. | $5.00 |

Post N.S.W. 25c, Interstate 40c.

## INTER COM TELEPHONES

15 Line Connections.

**$7 £3/10/- each**

## PILLOW PHONES

Low Imp. VC Matchings.
Ideal Hospitals, etc.

**$1.75 17/6 each**

NEW

## TRIO COMMUNICATIO RECEIVERS

9R59.D.E. SIDE BANDER

9 Valves. Mechanical Filter.
Design. New Bandspread.

**$159.50**

## J.R. 200 KITSET

As described in Trade Revi
July Issue.

**$89.00**

Wired, Tested and Guarant

**$99.00**

Other models see page 162

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# AMATEUR BAND NEWS AND NOTES

## Australis 1 To Have Three Systems

The technical details of the AUSTRALIS 1, artificial earth satellite, sponsored jointly by the Wireless Institute of Australia, Melbourne University Astronomical Society, and the Melbourne University Radio Club, have been finalised. The package will contain three systems, namely a High Frequency Beacon, Very High Frequency Telemetry and a Command System.

By Pierce Healy, VK2APQ*

'he high frequency beacon will radiate a / signal on 29.540MHz at 250mW out-. Every 80 seconds, the letters 'VK' will transmitted for 10 seconds, in morse. h 'VK' will take one second, with a -second break between VKs, so that five s will be sent during the 10-second iod. At the end of each 10-second VK nsmission, the HF beacon will revert CW operation for the next 70 seconds r which the 10-second VK sequence will repeated, and so on.

ecause of the heavy battery drain im-ed by the beacon it will not run con-iously and will be switched on and off command from ground stations. It is ed that it will be transmitting for about out of every 15 orbits completed by satellite every day. The command pro-mming schedule will be posted to all co-linators before the launch takes place.

he very high frequency transmitter will rate on 144.050MHz and will be modu-ed by an eight-channel audio tone tele-try system. The eight telemetry channels l comprise two temperature sensors, tery voltage and battery current sen-s, two horizon sensors, a magnetic coil itude sensor and a VK keyer. Each sor will be sampled for 10 seconds. At end of each 70-second telemetry read-, the 'VK' keyer will operate for 10 onds at the rate of one 'VK' each sec-l, with a one-second pause between each K.'

he system will operate in sequence with high frequency beacon, so that the s will appear on the VHF telemetry the same time as they appear on the HF acon. The VHF telemetry will be trans-tted continuously, from the time of nching until the battery is exhausted. It expected that the battery will have a of between two and three months.

he command receiver and the command oder will operate continuously, from the e of launching until the satellite's bat-ies are exhausted. The command receiver l operate on the two-metre band. The ction of the command system is to allow HF beacon to be switched on and off, that amateurs around the world can be en an opportunity to monitor the beacon l, it is hoped, use it as an aid in pre-ting 10-metre band openings. If this acon were not commanded off when necessary, the satellite's battery would be exhausted within a few weeks.

Other details of Australis 1 are: It will be an aluminium box-shaped satellite, measuring 17.5in x 12in x 6.5in. Four quarter-wave dipole aerials will serve the telemetry transmitter and the command receiver. A loaded dipole will be used for the 10-metre beacon. The satellite's battery will have a capacity of 1.15 kilowatt-hours and will weight 21lb. The total weight of the satellite will be 35 pounds.

A paint pattern on the outside surface of Australis 1 will be designed to keep the internal temperature of the satellite at approximately 20 degrees C. No solar cells will be carried on Australis 1, because of their very high cost at the present time, and because suitable types are not available in Australia. As this first satellite is an engineering test vehicle, the lack of solar power is of little importance, and it will be possible to obtain all the necessary data on the performance of the satellite during the two to three-month lifetime of the chemical batteries.

Australis 1 will carry a pair of small bar magnets together with a series of hysteresis rods that will align one axis along the earth's magnetic lines of force and will assist in damping out the satellite's tendency to tumble as it orbits the earth. If this is achieved it will reduce the fading of signals from the satellite caused by random tumbling. Data on the performance of this system will be transmitted via the VHF telemetry system.

Australis 1 will be launched from the Western Test Range, California, U.S.A., into a near-circular orbit, about 500 miles above the earth. Each orbit will take about 1 hour 42 minutes and the orbit will take the satellite between 70 degrees North latitude and 70 degrees South latitude. In this orbit, it will cover most of the populated areas of the world at least once a day.

Any satellite launched into orbit is useless unless there is an effective ground support system. At the present time, the Project Australis committee is working on the philosophy that there should be at least two primary stations in each State able to receive the VHF telemetry data from the satellite, monitor the HF beacon performance and, when necessary, send commands to the satellite for switching the HF beacon on and off.

Orbital computations for Australis 1 will be produced by the Australis Project organisation, using the Melbourne University's IBM 7044 to process tracking data supplied by amateur stations in Australia and around the world.

This orbital data will be broadcast daily and mailed weekly to all State and national co-ordinator. It is expected that the broadcasts will begin about a month before the launching takes place. These broadcasts will be made on the 80, 40 and 20 metre amateur bands.

To ensure that, following the launching of the satellite, full advantage can be taken of the orbital data that will be made available from the Australis project, it is advisable that amateurs and short-wave listeners should start thinking about getting suitable equipment into operation.

It is recommended that beam antennae used should be capable of being moved in both azimuth and elevation and a definite advantage will be gained by using right circular polarisation, rather than linear polarisation.

Depending on the checks on the dynamic test model being completed, and subject to no technical problems arising, it is anticipated that the flight model of the satellite will be completed in August.

The transistors for the satellite have been supplied by Fairchild (Australia) Pty. Ltd.; capacitors by Ducon; resistors by Cannon Electric; battery by Union Carbide Aust. and the aluminium by Comalco.

### OSCAR PROJECT

The Oscar Project newsletter issued at the end of April stated that events are moving along steadily in the project organisation. Elections have been held and several groups are actively engaged in building hardware for future Oscars.

Elections held in January installed two new directors, Bob Walton, W6CYL and Chet Pearson, WA6CXV. Both Bob and Chet have been active in Oscar for several years. Bill Stevenson, W6LUQ, was elected chairman of the board and Hank Brown, W6HB, was elected vice-chairman. The newly constituted board of directors then proceeded to elect the following officers for 1966: Harley Gabrielson, W6HEK, president; Lance Ginner, K6GSJ, vice-president; Ed Hilton, W6VKP, secretary; and Bob Walton, W6CYL, treasurer.

The organisation has been divisionalised to help spread the work load. Hank Brown, W6HB, is handling operations, Chuck Towns K6LFH, public relations, and Lance Ginner, K6GSJ, the space aspects, such as package development and launch co-ordination. These men will be organising and co-ordinating these activities.

OSCAR IV. It was assumed that Oscar IV ceased operation during orbit 211 on March 16. However, a report from ZL1WB gave details of tracking the satellite up to April 10. His observations since March 19 have been for short durations, of not more than 15 minutes, and the signal was apparently quite weak. The present location of the orbit, perigee at northernmost extreme and apogee at southernmost limit, is undoubtedly responsible for the lack of northern hemisphere observations.

The short tracks reported by ZL1WB strongly indicate solar panel damage, but it is not known at present if the damage is permanent, due to radiation, or temporary, due to temperature effects. Only time will tell. The lack of tracking reports makes it impossible to generate orbit predictions at the present time. If Oscar IV continues to operate, it may be possible to get additional southern hemisphere tracking data and make new orbit predictions by the time northern hemisphere observers can again "see" the satellite.

OSCAR V. Development of new satellite packages has been under way for several months. One group in Germany is

**lews and notes of Divisional and Club tivities, submitted for inclusion in ese columns should be forwarded ect to Pierce Healy, 69 Taylor St., Bankstown, N.S.W.**

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BRIGHT STAR RADIO

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actively working on a package with char
teristics similar to Oscar III. Another gro
in Sunnyvale, California is at work on
2-and 10-metre package. There are so
432MHz and 1296MHz beacon modu
and a multi-channel telemetry pack
already built and ready to go. Work is a
proceeding on another unit similar to Os
IV that will be suitable for a near-synch
nous orbit. A group in Canada is a
working on an amateur satellite project.

The Newsletter states: "All in all, the
ure looks rather promising, as far as am
eur space activity is concerned."

It also points out that it must be und
stood by all concerned that any rides i
space of amateur designed and built sa
lites, are obtained through the good gra
of the launching agencies and are norma
granted only on there being space availa
on a launching vehicle. It is also nec
sary for the equipment to be built bef
an approach can be made to the approp
ate agencies for assistance to launch
package.

## W.I.A. Activities

The production and circulation to D
sions, early in June, of a 71 foolscap p
record of the minutes of the 1966 Fede
Convention of the W.I.A., held in Brisb
last Easter, was the result of many ho
of voluntary work by members of the F
eral Executive. The minutes are an exc
lently prepared and concise report on
aspects discussed at the convention.

Members of Federal Executive who
dertook the mammoth task of editing s
eral thousand feet of tape recordings, s
plemented by hand-written notes, are to
congratulated on a task well done.

There is no doubt, that the final d
sions made by the divisions, when consid
ing their action in respect to ratifying
decisions of Federal Council, as reco
ed in these minutes, will have a last
effect on the future of the amateur
vice in Australia.

### NEW SOUTH WALES

The minutes of the Federal Convent
were officially received at the June meet
of the New South Wales division on Fri
25, at the Wireless Institute Centre.

After a brief summary of the conte
it was agreed that the council of the d
sion should consider them further and
cide what action should be taken towa
ratification.

A small but very appreciative attenda
of members heard a very interesting
humorous lecture by Mr Langford-Smith
"Early aviation and communications in
Northern Territory."

Mr Langford-Smith was the origi
flying missionary in Arnhem Land, usin
Gypsy Moth aircraft he called "The
Pilot" and was the originator of a Fly
Doctor Service before the advent of pe
wireless.

With many interesting anecdotes on c
ditions and happenings in remote bush
sions, he related stories on methods of co
munication calling for medical assistan
using message sticks, carrier pigeons, pe
wireless and the first aircraft to be used
this work in the outback area of Australi

A vote of thanks proposed by Ivan A
VK2AIM, was carried by a very hea
round of applause.

The Divisional Council has been brou
up to full strength by the appointment
Cyril Henderson, VK2CH, to fill the vaca
due to the resignation of Kevin Coll
VK2ANY. Cyril is a well known mo
operator on 7MHz as well as on 3.5M
from his home station.

### HUNTER BRANCH

Two lectures were given at the J
meeting of the Hunter Branch, held in
Technical College, Tighes Hill.

The first speaker was Len Da

2ZFD, who enlightened an attentive
ience on new methods in use to suppress
tion interference in car radio receivers
le listening to distant signals. He
ntioned especially the ferrite bead tech-
ue and said this was so far the most
ctive method. Len also introduced mem-
s to coaxial capacitors and surprised
m all when he mentioned their price.

he second lecture was given by Ian
e VK2ZIF, who spoke on the subject of
nverters." During his talk he spoke about
types of converters normally used by
ateurs for both HF and VHF operation
made special mention of the converter
has developed using nuvistor triodes in
unded grid configuration.

o impressed were members with the
ils of this unit, that Ian has been
suaded to make this the subject of a
ject to be constructed by Branch mem-
s. This will be a full project kit of all
ts with assistance in building and testing
will be available to members at com-
tive cost. Further details will be given
coming meetings and news broadcasts
m the Branch station VK2AWX.

he winner of the John Moyle Memorial
ional Field Day low power portable
ion was VK2ATZ, the station of the
stlakes Radio Club. This station was
nned by Susan Brown, VK2BSB; David
sell, VK2BSC and Jan Oosterveen,
2BJO, with Paul Linsley, a short wave
ener, as log keeper.

ven though there was a good deal of
npetition from other States the club
ion won by a considerable margin. The
smitters operated on the 3.5MHz and
Hz bands and were located on Mount
nibung, near Newcastle.

im Thompson, VK2AHT, now has his
40-metre rotatable beam in operation,
s mounted atop of a 90 foot tower
is a feature of the Toronto lakeside
line. Jim is now receiving reports, from
ions in the U.S.A., that his signals are
strongest heard from Australia on 40
res as well as on some of the other
ds.

he next meeting of the Hunter Branch
be held in Room 6, Clegg Building,
vcastle Technical College, Tighes Hill,
Friday, August 5th, commencing at
m. Visitors are welcome.

### CENTRAL COAST BRANCH

here was a record attendance at the
e meeting of the Central Coast Section
the W.I.A. held on Friday evening 17th.
re were several visitors and a number of
nbers who had not attended for some
e.

he Branch President, Lindsay Douglas,
2ON, demonstrated a RF probe and a
acity meter. Secretary, Frank Jarvis,
2AFJ, described his six-meter converter
Gordon Proctor, an associate member,
e a colourful demonstration of his con-
ser tester. The outstanding aspect of all
"home brew" equipment was the im-
visation in the true amateur tradition.

he August meeting of the branch will
held on Friday evening, August 19th,
8 p.m. in the School of Arts, Gosford.
itors are always welcome to attend.

### VHF AND TV GROUP

t the June meeting of the VHF and TV
up, Keith Finney, VK2KJ, gave a con-
cing "Demonstration of the Magician's
" Keith completely mystified the audience
many tricks and a member of the
ience was heard to remark that they
e just as puzzling as the disappearance
the grid drive to the final of his
MHz transmitter.

he Contest Committee of the group is
nging for a local VHF/UHF Remem-
nce Day Contest along the same lines
ast year. All VHF operators are invited
articipate.

im Mills, VK2ZTM, will be making an
nsive mobile tour of Northern Australia
ing August. He will be operating on
144MHz and 52MHz bands and will be looking for contacts.

### N.D.A.R.C. FIELD DAY

A total of 77, made up of 30 amateurs together with their families and friends, attended the first Field Day to be organised by the Nepean and District Amateur Radio Club. The event was held on June 12th with activities centred at the Penrith Civil Defence Headquarters at St. Marys. Despite the wintery conditions of an overcast sky and a cold wind, the enthusiasm of those attending was not dampened.

The first event was a mobile scramble for the top scorer in both VHF and HF sections. Contestants were required to make as many contacts as possible while en route to the field day. The contest was of one hour duration and the starting point was at least 15 miles airline from the final rendezvous. Winner of the HF section was Harold Burtoft, VK2AAH, with Bob Lear, VK2ASZ, taking the honours for the VHF section.

Four mobile events were staged during the day and the "Le Mans" type of starting procedure introduced, provided the spectators with some interesting sidelights.

Three of the events were Hidden Transmitter Hunts, while the fourth was a continuing Transmitter Hunt. A pedestrian Hidden Transmitter Hunt proved that these events are very popular but are dominated by the younger and possibly fitter competitors. Novelty events for the ladies and children were also keenly contested.

An interesting aspect of the activities during the day was a point-to-point communication net manned by the Penrith Civil Defence organisation. The fact that this was the first occasion on which the C.D.O. and the W.I.A. had combined in a field day of this nature was commented upon by the President of the New South Wales Division, W.I.A., Tom O'Donnell, VK20D, during his address to those present.

The results of the various contests were:

Mobile Scramble: HF Section: Harold Burtoft, VK2AAH;VHF Section: Bob Lear VK2ASZ.

First 7MHz Hidden Transmitter Hunt: First: Harold Burtoft, VK2AAH; Shortest Distance: Dennis Wheaton, VK2AWW.

144MHz Fox Hunt: Winner: Bob Lear, VK2ASZ; Runner-up: Harold Burtoft VK2AAH.

Second 7MHz Hidden Transmitter Hunt: Winner and Shortest Distance: Harold Burtoft, VK2AAH.

144MHz Hidden Transmitter Hunt: Winner: John Lark, VK2ALK; Shortest Distance: Harold Burtoft, VK2AAH.

144MHz Pedestrian Event: David MacNaughton, VK2ZVW.

Free-for-all Novelty event: Winner: Mrs Greenhaly; Runner-up: Duncan Grevas.

Ladies' Novelty Event: Sue Irvine.

Men's Quiz: Phil Irvine, VK2ZPI.

Ladies' Quiz: Helen Drew.

Guessing Conpetition: Helen Drew.

Lucky Tickets: Tom O'Donnell, VK2OD. Geoff Mann, VK 2XA.

The Club expresses its appreciation of the excellent prizes and literature donated by: Amalgamated Wireless Valve Co. Pty. Ltd., Fairchild Australia Pty Ltd., O. T. Lempriere and Co. Ltd., Philips Electrical Pty. Ltd., Mullard — Australia Pty. Ltd., International Resistance Co. (Australasia) Pty. Ltd., Aerostat Ltd., W.I.A., Roland Grevis.

### CESSNOCK RADIO CLUB

Ray Robinson, a member of the Cessnock Radio Club, who has been studying under the expert tuition of Chris Cowan, VK2PZ, has been notified of his success in gaining the A.O.L.C.P. at the May examination conducted by the Postmaster-General's Department.

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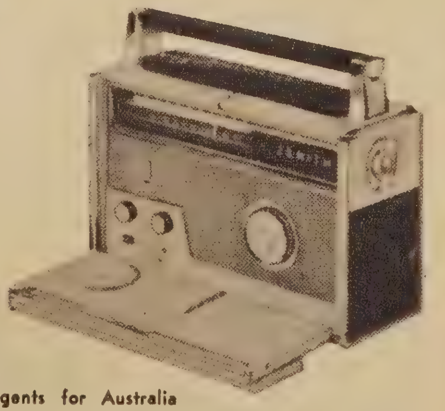
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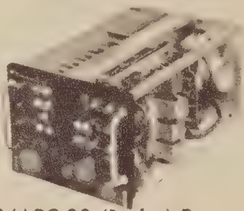
| 3MFD | 100V | Pigtail | 10c ea. | $1.00 per dozen |
| 10MFD | 12V | Pigtail | 10c ea. | $1.00 per dozen |

### ROTARY SWITCHES
3" Diam. (MSP Type) 3 Bank. 1 Pole, 24 position. Brand new. $2.75 (27 6).
1 Pole, 12 position, Standard MSP, 10/ each.



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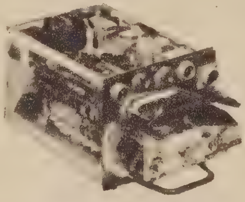

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### SPECIALS
Panel Mounting, Cartridge Fuse Holders. 30c. $2.00 for 8.
Microphone Plugs, American Type, Ring, Tip and Sleeve, 50c.

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G.E.C. Panel Meters, 0-50 milliamp. 3¼" round. 2½" round mounting hole. Brand new, $1.75.

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### RONETTE CARTRIDGES

| | |
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| 105 Stereo Turnover Diamond Stylus | $7.00 |
| TX88 Mono | $4.50 |
| Studio "O" | $4.50 |

### SONOTONE

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|---|---|
| 8TA Ceramic Stereo Turnover | $5.52 |
| 9TA Ceramic Stereo Turnover | $5.52 |

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OUTPUT TRANSFORMER, 300 ohm C.T./ ohm. E type. $1.00.
DRIVER TRANSFORMER. 3000 ohm C.T 1330 ohm. E type, $1.00, or $1.75 pair.

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|---|---|
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| D.P.D.T. | 10/ |

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| 0.05 | " | 350 " | |
| 0.01 | " | 1000 " | |
| 0.005 | " | 1000 " | |
| 0.002 | " | 1000 " | |
| 0.001 | " | 1000 " | |

### CHOKES

| | |
|---|---|
| 7-5 H. 125mA | 30/ ea |
| 14H. 60mA | 12/6 |

### PLUGS AND SOCKETS

| | |
|---|---|
| Octal Plug | 3/6 ea |
| Octal Socket | 1/6 |
| 5-pin Speaker Plugs | 2/6 |
| 4-pin Speaker Plugs and Sockets | 1/9 ea |
| 6-pin Jones Plugs and Socket | 7/6 ea |
| Pye Plugs | 2/ ea |
| Pye double bulk Chassis Sockets | 2/6 |

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### POTENTIOMETERS
Wire wound, 1½ inch diameter. Sizes available:
5 ohms. 10 ohms. 25 ohms, 50 ohms, 1 ohms, 250 ohms, 500 ohms, 1000 ohms. 20 ohms, 10K ohms, 50K ohms, 4/ each.

### SPECIAL BARGAINS

| | |
|---|---|
| P.M.G. Strip Boards, containing 24 Jacks. | 30/ ea |
| P.M.G. Strip Boards, containing 48 Jacks. | 50/ ea |
| Head Phone Cords, new | 4/6 p |
| 3-pin Plug and two yds Cord | 4 |
| Mixed bags of Resistors (50) | 12 |
| P/M Fuse Holders | 4/6 ea |
| 72 ohms Co-ax Cable, 35ft lengths, 3/16 in diameter | 1 |
| 72 ohm Co-ax Cable, 27yd lengths, 3/16 in diameter | 2 |
| Vibrators, 122 Type | 20/ ea |
| 122 Aerial Packs | 60/ ea |
| 12-core Cable with Plug, 22 yards long, | 5 |
| Wrecked 733D Receivers, less valves | 4 |
| P.M.G. Key Switches | 7/6 ea |

# HAM RADIO SUPPLIERS

Phone 86-6465, 81-1935

Established 194

his Club is closely associated with the l Defence organisation in the Cessnock . Intending members should contact is Cowan, VK2PZ, 126 Aberdare Road, rdare.

### VICTORIAN DIVISION

ue to TVI problems the Sunday evening oadcast on the 1.8MHz and 3.5MHz ds of the VK3WI Sunday morning news dcast, from the rooms 478, Victoria ade, Melbourne, has been temporarily inated. Instead a rebroadcast is made on 32MHz AM; 144.1MHz AM; and 146-z channel B, FM, by John Beckett 3FE, at Olinda.

simultaneous rebroadcast is made each day morning on 432.3MHz, by Cyril nonds, VK3AEE. At the conclusion of broadcast, Cyril takes reports on that d.

social gathering of the North - West e of the Victorian Division was held Sunday afternoon, June 12th, in the /.A. Rooms at Wangaratta. Of the 16 nbers who attended, accompanied by r families, some travelled from as far d as Echuca and Seymour, operating oile enroute.

fter a period of "Eyeball QSOing" the e serious part of the get-together was . Bob Wallace, VK3UW, of Wodonga re-elected Zone President. Other tions were: Arthur Lock, VK3AUL, of umburra as Secretary, and Bob, 3AJN, as correspondent.

he meeting also resolved that the Zone k-up would be started again. The net be under the control of either Greg nardson, VK3AWT, or Bob, VK3AJN. call to Zone members will be made on 80-metre band at 8.00 p.m. each Friday t. All amateurs in the North - Eastern e are invited to join the net hook-up.

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## ROM CYCLES TO HERTZ

rom this issue ELECTRONICS Ausa changes from the time honoured terology - cycles-per-second- (cps) to the Hertz.

ow, cps—becomes—Hz; KC—KHz and — MHz. As foreshadowed in the Feby edition of these notes, it now seems appropriate time to coin a phrase or for amateur use.

ow about "KERTZ" for KHz; and ERTZ" for MEGS?

---

### QUEENSLAND.

he Office bearers of the Queensland ision of the W.I.A. for 1966 have been ted as follows:

| | |
|---|---|
| resident and Chairman of Committee; | L. Blagbrough VK4ZGL |
| ice-Presidents | R. Vickary VK4VX<br>A. Carter VK4LT |
| onorary Secretary | N. Wells VK4NB |
| ssistant Secretary | R. Campbell VK4ZRC |
| onorary Treasurer | D. Watson VK4DZ |
| inutes Secretary | L. Sharp VK4NS |
| isposals Officer | C. Higgins VK4ZCV |
| wards QSL Officer | J. Files VK4JF |
| utwards QSL Offi. | R. Holland VK4AQ |
| TC Editor | L. Blagbrough VK4ZGL |
| ivisional Sub-Edit. | R. Vicary VK4VX |
| HF Representative | T. Lane VK4ZAL |
| ibrary Officer | P. Green VK4VS |
| tation Man. VK4WI | A. Hansen VK4OL |
| ssist. Station Mans. | A. Carter VK4LT<br>V. Jeffs VK4VJ |
| Station Manager - VK4ZWI | L. Blagbrough VK4ZGL |
| lass Manager | J. Morris VK4JG |
| ssist. Class Man. | S. Carter Assoc. |
| Space communications Co-Ordinator | L. Blagbrough VK4ZGL |
| echnical Officer | G. Down VK4XY |
| usiness Manager | K. O'Farrell VK4OF |
| ountry Councillor | A. Carter VK4LT |
| .R.S. State Supv. | F. Chapman VK4TH |
| .R.S. Examiner | J. Maciver VK4JE |
| .R.S. Liaison Officr | C. Taylor VK4UC |
| ublicity Officer | P. Brown VK4PJ |
| Federal Councillor | D. Portley VK4DP |
| Federal Councillor Observer | R. Vickary VK4VX |
| S.W.L. Registrar | W. Jehn WIA-L4001 |

### WESTERN AUSTRALIA

Visitors to the West are reminded that the General Meeting of the Western Australian Division is held on the third Tuesday of each month at the Perth Technical College. Proceedings commence at 8 p.m. The monthly meetings of the VHF Group are held on the fourth Monday of each month in the D.C.A. Workshop Canteen, 86 Guildford Road, Maylands at 8 p.m. Interstate visitors are always welcome to attend these meetings.

### I.T.U. NEWS

The Administrative Council of the International Telecommunication Union, at a recent session held in Geneva, elected 10 members of a special study group for the preparation of a draft Constitutional Charter for the Union. The 1965 I.T.U. Plenipotentiary Conference, held in Montreaux, decided that such a draft should be prepared and distributed to members of the Union for consideration at least one year before the next Plenipotentiary Conference, scheduled to be held in Geneva in 1971.

The 10 members of the study group elected—two from each of the five geographical regions—were:

Region A (The Americas): W. H. Watkins (U.S.A.); E. Machado de Assis (Brazil).

Region B (Western Europe); R. Vargues (France), H. C. Greenwood (United Kingdom).

Region C (Eastern Europe and Northern Asia): S. Houdek (Czechoslovakia); E. A. Motine (U.S.S.R.).

Region D (Africa): G. C. Okoli (Nigeria); M. Ben Abdellah (Morocco).

Region E (Asia and Australia): R. E. Butler (Australia); N. Kayata (Lebanon).

### DX-PEDITION NEWS

From Tristan da Cunha, Alan, ZD9BE is very active, operating almost every day between 1900 and 2100 G.M.T. He is operating split frequency, transmitting on 14.241MHz and listening on 14.250MHz. Several Log tapes have been received at the DX-pedition of the Month Centre and QSL-ing is under way. It is expected that cards for Alan's previous C.W. and A.M. operations will be issued along with those for his current S.S.B. activity.

### The W-CR7-A

The League of Radio Amateurs of Mocambique, (L.R.E.M.), have made available a new award, to be known as "W-CR7-A" for any foreign amateur station submitting proof of having worked 15 licensed CR7 stations, either on phone or CW using any of the amateur frequency allocations.

Stations in the call areas ZS; ZE; VQ2; VQ3; VQ4; VQ5; OQ; FB8 and CR6 to prove 25 QSO's instead of 15.

Contacts must have been made after 12th January 1949. QSL cards must be accompanied by a list but if any QSO has not been confirmed it may also be included in the list, and the L.R.E.M. Secretary will do his best to obtain the missing cards.

The cards, list and five I.R.C. must be sent by applicants to: Liga dos Radios Emissores de Mocambique, Caixa Postal 812, Lourenco Marques, Mocambique.

### BEACON TRANSMITTER

The British Post Office has given permission for another amateur radio VHF beacon transmitter to be set up at Lerwick

GET YOUR LICENCE

Do you want to get your licence but cannot attend classes personally? The W.I.A. (NSW. Div.) conducts a Correspondence Course to cover all aspects of the Amateur Licence.

*Fees. $14.00 per stage or $36.00 per course.*

*Enquiries to:*

THE COURSE SUPERVISOR,
14 ATCHESON STREET,
CROWS NEST, N.S.W.

CRYSTAL PE DIVISION

Manufacturers of Quartz Crystals for Frequency Control and Crystal Filters for Highly Selective Circuits, Announce:—

NEW LOWER PRICES FOR CLOSE TOLERANCE GOLD PLATED CRYSTALS FOR AMATEUR APPLICATIONS

- 1.8 Mc/s to 14.999 Mc/s ± 0.005% in Style "D" holders, ½in pin spacing. Amateur net $5.39 each including tax.
- 15 Mc/s to 47.999 Mc/s ± 0.005% in Style "D" holders, ½in pin spacing. Amateur net $5.78 each including tax.
- 48.0 Mc/s to 61.0 Mc/s ± 0.005% in Style "D" holders, ½in pin spacing. Amateur net $6.26 each including tax.
- 100 Kc/s ± 0.005% in HC13/U holders, ½in pin spacing* Amateur net $10.00 each including tax.
- 1 Mc/s ±0.005% in Style "D" holders, ½in pin spacings* Amateur net $10.00 each including tax.
- 455 Kc/s nominal Crystals for Filter applications in Style "D" or "E" (B7G) holders. Amateur net $10.00 each including tax.

* Specially designed for Crystal Calibrator purposes.

Many other types and tolerances are available from our standard production. Please consult us on your Crystal requirements.

TERMS: Cash with order. Please state call sign.

PYE PTY. LTD.

Clarinda Road, Clayton, Victoria. P.O. Box 105, Clayton. Tel.: 544-0361.
State Offices in Adelaide, Brisbane, Hobart, Perth and Sydney.

## SOUND PROJECTORS

Cinevox Prefect 16mm in good working order. 240v operated, complete with speaker and amplifier.

**$115.00**

## CIRCULAR SLIDE RULE

3¼in diameter. Will do the same work as the conventional slide rule. Instruction book included.

**$1.25 each. Post 10c**

## REFLECTOR GUNSIGHT

Contains these lenses:
1 Lens 1in Focus, 1½in diam.
1 Lens 1 11/16in Focus, 1¼in diameter.
1 Air-spaced Lens, 1¼in diam.
1 Filter Lens, 1 Graticule,
1 Lampholder.

**$1.85 each**

Post: N.S.W., 30c: Interstate, 40c.

## PMG TYPE TELEPHONES

Standard desk type with magneto calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected toge'her on single line.

**$23.00**

(2 TELEPHONE SETS)

30c cartage to rail. Freight payable at nearest attended railway station.

## AERIAL CAMERAS

F.24 Mark IV 2.9 Lens, stops 11, 8, 5.6, 4, 2.9.
With 3in x 8in F1 Dallmeyer Lenses complete with wooden case.

**$39.00**

50c Cartage to Rail. Freight payable at nearest attended railway station.

## SHIPS' CLOCKS

(No bell). Smith's 8-day, fully jewelled. Original cost $120. Special 7in brass $25. 10½in Seth Thomas splash-proofed bakelite

**$30**

Post N.S.W., 70c: Intersta'e, 95c.

## ECHO SOUNDER

Depth and Fish Finder. Transistorised, with Neon Flasher Indicator, complete and Guaranteed.

**$85.00** Post $1.60

## 12 CREED TELEPRINTER

Tape printers model 47.R, 240 Volts operated.

**$35.00**

## TELEPHONE WIRE

21 gauge copper, plastic covered. Ideal telephone or bell wire. 1,320ft coil of twin (equal ½ mile). $7.00 per coil.
Post, N.S.W. 70c: Interstate $1.20.

## 3000 TYPE RELAYS

P.M.G. 200 Ohm — 1,500 Ohm Coils, $1.25 each.

## 2-WAY RADIO

NUMBER 22 (AUST.)

Untested without meter or leads, with power supply less relays. $15.00. 50c cartage to rail. Freight payable at nearest attended railway station.

## AMPLIFIER

Subminiature 4-Transistor, Audio Push-Pull.

**$7.00** Post 50c

## GOOSE NECK LAMP

NEW. IDEAL FOR DESK or WORK BENCH. Adjustable shade, strong metal lacquered base and frame. Height 18in. Complete with lead.

**$1.25**

Post and packing. $1.00.

## DRAFTING MACHINE

Genuine Swiss-Wiles (Without Scale).

**$19.50** Post $1.20

P.M.G. Phone Jack and plugs. 25c each. 45c the pair.
Post 7c.

## NIFE CELLS

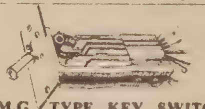
1.2 Volt fully charged, 4in x 3in x 1in 4 AH.

**$1.00 each**

Post, N.S.W., 25c; Interstate, 35c.
1.2 volts 15 AH. 8in x 4in x 2in. $2.95.
2.4 volt 10 AH. 6in x 2½in x 2in. $2.50.
Post, N.S.W., 30; Intersrate, 40c.

## PERSPEX

Slightly domed shape, 16in x 12in, $1.55. 2ft 6in x 18in tapering to 6in, $1.75. 2ft 6in x 2ft, $2.45. Domed approximately 3ft 6in x 2ft, $5.50.
50c cartage to rail. Freight payable at nearest attended railway station.



P.M.G. TYPE KEY SWITCHES. 45c each. Post, 15c.

## VALVES

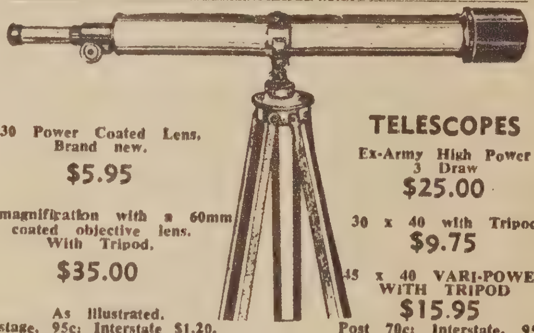
### BRAND NEW

IN CARTONS.

Special discount for quantity

| | | | |
|---|---|---|---|
| 6SN7GT | 95c | 6AG5 | 50c |
| 89 | $1.00 | X61M | $2.20 |
| 12SA7 | $1.25 | CV850 | $1.50 |
| 6H6 | 45c | 18H6G | 30c |
| 41 | $1.25 | 832 | $5.00 |
| 5U4G | 95c | 6F13 | 75c |
| 77 | $1.00 | 6AK5 | $1.50 |
| VR150-30 | $1.00 | 6X4 | $1.00 |
| 5CPI | $3.95 | 6F8 | 75c |
| EF50 | 35c | 6N7 | $1.00 |
| 6U7 | 75c | 12SK7 | 50c |
| V1103 | $1.00 | VR1120 | 50c |
| VH120 | 75c | VR118 | 75c |
| 1L4 | $1.0 | VR65 | 25c |
| 5Y3 | $1.50 | 6R7GT | 50c |
| 6C4 | 50c | VT4C | 75c |
| CV2184 | $2.25 | AU5 | $1.00 |
| | | 80 | $1.25 |
| | | 6AK5W | $1.50 |

PLEASE ADD POSTAGE ON ALL ARTICLES.



30 Power Coated Lens, Brand new.

**$5.95**

60 magnification with a 60mm coated objective lens. With Tripod.

**$35.00**

As illustrated.
Postage, 95c; Interstate $1.20.

## TELESCOPES

Ex-Army High Power 3 Draw

**$25.00**

30 x 40 with Tripod

**$9.75**

45 x 40 VARI-POWER WITH TRIPOD

**$15.95**

Post 70c; Interstate, 95c.

## HIGH STABILITY RESISTORS

I.R.C. brand new ½w., 1w, 2w, tolerances between 1 and not exceeding 5% including 100, 360, 560, 750, 15K, 22K, 27K, 100K, 180K, 220K, 560K, 820K, ohms. Usual price 40c each, 50 assorted different values for only

**$3.75 Post 15c.**

## GENUINE VARIACS

0-115 V.A.C. 18 Amps, $29 each, or couple two together for 240 V.A.C.

**The two for $45**

## Genuine American Zenith Variacs

0-115 V.A.C. 7.5 Amps, $19.50 each or couple two together for 240 V.A.C.

The two for $36.

50c cartage to rail. Freight payable at nearest attended railway station.

## 522 TRANSCEIVERS

100 to 150 m/cs.

**$35.00**

## TR1934 TRANSCEIVERS

100 to 125 m/cs.

**$33.00**

## FRACTIONAL 240 VAC MOTORS

1/25 h.p., new, with coupled 2-speed gearbox. 1425 and 300 r.p.m. Ideal for rumbler, etc.

**$20**

Post N.S.W., 70c; Interstate, 95c.

## AWA OSCILLOSCOPE

Calibrated with delay time base. 5in, 240 vac., perfect.

**$195.00**

## C.M.A. CABLE

240 volt 3/.036 black, new and perfect. 100 yds. rolls, $3.00, 6 or more.

**$2.50 a roll**

30c cartage to rail. Freight payable at nearest attended railway station.

## MICROMETERS

Brand new Goodell-Pratt, 0 to 1in, $7.50; Slocombe, 1in-2in, $7.85; Starrett 1in-2in, $9.85.
Post, 32c.

CHOKES, 7.5H, 60mA .. .. .. 95c
VIBRATORS, 6 volts, 7-pin, 75c each.
UNISELECTORS. 4 BANK HOMING TYPE .. .. $4.00
INVERTERS, 26v-115v 2Kw 400 cycle .. .. .. .. .. .. .. $9.50
HAND MICROPHONES, with Press-to-Talk Switch .. 95c ea.
Post, N.S.W., 25c; Inters'ate, 30c.
INSTRUMENT TRIPODS, sturdy wooden frame, Telescopic. Extend to 4ft 6in .. .. .. $13.00
SELSYN MOTORS MAGSLIP Mk. II .. .. .. .. $5.25 ea.
No. 19 2-way radios, with hand set, power supply, leads. $35.00
Meggers, bridge type, complete and tested .. .. .. .. $75.00
EVERSHED and VIGNOLES, 500 volts.

## H.T. TRANSFORMERS

2,000/0/2,000 volt. Primary 28 volt 50 cys. rated at 1.75 Kva. Ideal linear amplifier, etc.

**$27.00**

## BINOCULARS

PRISMATIC. Coated Lense
Brand new. Complete with ca
8 x 30 .. .. .. .. .. .. $19
7 x 50 .. .. .. .. .. .. $26
10 x 50 .. .. .. .. .. .. $27
12 x 50 .. .. .. .. .. .. $28
Post, N.S.W. 70c; Interstate, $1

SPECIAL ARMY RELEAS

## TELESCOPES

ALL LENSES
"ASTRONOMICAL" QUALIT

### General and Marin Use

4 x 40 Genuine HANDL
Cost $60.00. Our Price, $6.
7 x 40 GENUINE OTW
ANGLE TELESCOPE. Cost $
Our Price .. .. .. .. .. $9
15 x 40 variable Power Otw
$15.50.

Freight payable at nearest attended railway station.

## .420 Mc/s OSCILLATOR

Self-excited 6J6 with power sup
and modulation transformer. 5i
5in x 5in box. 240 volt opera

**$15.00**

## BUBBLE SEXTANT

Mark 9 without bubble $9
With bubble .. .. .. .. $

## RECORDING TAPE

SCOTCH BRAND.
EX-WOOMERA.
SLIGHTLY USED.
PERFECT ORDER.

Can be used for home video, t
recording equipment, etc.
2,400ft 12in Reel ½in Top Gr
Cost $14.50. Our price $7
roll. Post 70c; Interstate,
Also same in ¼in. Ideal for
fessional quality audio record
1200ft 7in reel ¼in $2.75. Post
600ft 5in reel ¼in $1.68. Post
200ft 3in reel ¼in 65c. Post

## SCOOP PURCHAS

Gramo. Motors, New. Made
U.S.A. 4-speed. 240 volt A
50 cyc. Only $2.75 each.
Post, N.S.W., 30c; Interstate,

## 240-110 VOLT 6KV TRANSFORMERS

Encased, including switches,
new. $50.

Top grade, fully enclosed tr
former. 1 Kva primary 218/
vac. 50 cycs. secondary 6 v
37 volts, 53 volt, 60 volt, $3

## LEAD ACID BATTERIES

New 2 volt 1.5 amp. $1.75, 12
0.75 amp. $3.75.
Post, N.S.W., 25c; Interstate,

SPECIAL lucky dip valve of
15 new valves in cartons
only $2.00. We haven't got t
to sort them, so you reap
benefit. Post. 30c.

## SOLENOIDS

Plunger Type 12V 300M.A.
electric camera control.
MINIATURE TRAINS.
radio. etc. $1.25. Post, 10c.
200 Mill. amp., 240 volt,
push movement.
$1.25. Post, 10c.

## BATTERY CHARGE

6 or 12 volt, 2½ amp. $9
Post, N.S.W., 70c; Interstate,

## TELEPHONES

Sound Powered. Can be used
Microphone and Receiver. N
With 50ft cable.
$3.85 pair.
Post, 25c; Interstate, 40c.

# Deitch Bros.

## 70 OXFORD STREET, SYDNEY

*SORRY, NO C.O.D.*

Shetland Islands on a frequency of MHz (4 metres).

hoped that this transmitter will be ration by May 1, and will be in n to the 10-metre and 2-metre s already in operation. The call sign GB3LER.

four-element Yagi aerials will be ith automatic switching, one beamed north for auroral reflection obser- and the other south for tropospheric poradic E propagation experiments. ronics Weekly," March 10, 1965.)

### MARITIME MOBILE

British Post Office has announced Maritime Mobile permits are now le to applicants who hold a current Kingdom amateur operator's licence. nds on which operation is permitted e 10; 15; 20 and 40MHz amateur ions.

details are known at present about restrictions may still apply to this f operation but it is hoped that many rs who are ship's operators will be avail themselves of this facility.

### THE U.S.S.R. AMATEUR

n time to time, comparisons are made n the various licensing requirements lied to the Amateur Service in differ- untries. The allocation of the differ- ll letter groups as applied to indivi- stations is often obscure.

licence groups as applied to the R. amateur are as follows.

**e Groups:**

rators between 16 and 18 years of hree classes of licence, all telephony

1. 3.5MHz - power 40 watts, single side band.
   28MHz - power 200 watts.
   144MHz; 430MHz and 1296MHz - power 5 watts.
2. 3.5MHz - Power 40 watts single side band.
   28MHz - Power 40 watts.
   144MHz; 430MHz and 1296MHz - Power 5 watts.
3. 28MHz; 144MHz; 430MHz and 1296MHz - Power 5 watts.

**tors from 18 years old:**

1. All amateur bands - Power 200 watts for A1; A3 and SSB.
   144MHz and above - Power 5 watts.
   RTTY is allowed on specified bands.
2. 3.5MHz; 7MHz and 14MHz power 40 watts for A1; A3 and single side band on 3.5MHz.
   144MHz and above - power 5 watts.
   RTTY on specified bands.
3. 3.5MHz and 7MHz - power 10 watts, single side band on 3.5MHz.
   144MHz and above - power 5 watts.

**Licences:**

HF and UHF bands: For operators 12 years of age.

IF bands: for operators from 14 years

pplicants for an amateur licence are an oral exam as well as a written on radio and electrical theory by a of licensed amateurs. The morse code also conducted by licensed amateurs. he three letter callsigns commencing he letter "K" are club stations. Other letter callsigns are issued to those ed in the 16 to 18 year old class. letter callsigns are issued to the 18 nd over group.

ommercial amateur radio equipment is vailable in the U.S.S.R., so the accent home designed and built equipment is considered to be generally of a very standard.

ne point of particular interest is the hat the Russian amateurs lost the use 1.8MHz band due to the lack of y on that band.

here are 58 Russian call areas, with her sub-division within Regions.

## "WORKED ALL EUROPE" DX CONTEST

The "Worked All Europe" DX contest sponsored by the Deutscher Amateur Radio Club will be held over the second weekends of August and September. The object of this contest, the 12th to be held, is for as many contacts as possible to be made between radio amateurs residing in Europe and amateurs throughout the remainder of the world.

**CONTEST RULES:**

CW Section: Saturday, August 13, 0000GMT; Sunday, August 14, 2400GMT.

Phone Section: Saturday, September 10, 0000GMT; Sunday, September 11, 2400GMT.

The CW and Phone Sections are separate contests and entry may be made in either or both.

Frequencies: 3.5MHz; 7MHz; 14MHz; 21MHz and 28MHz.

**Contest communication and scoring**

(a) A valid QSO is one conducted between a European amateur and an amateur not located in Europe (note UF, UG and UD are situated in Asia).

(b) European and non-European stations will exchange a control number consisting of two parts. The first part is a numeral RST or RS report and the second part consists of a three digit figure representing the QSO number. Each station will number its QSO's chronologically, starting with 001 and will continue them serially even though operation may be conducted on different bands.

(c) Each station may be contacted for the exchange of a control number only once per band.

(d) A confirmed (either by "OK" or "R") exchange of control numbers will count ONE point. A confirmed contact on 3.5MHz will count TWO POINTS.

(e) Unconfirmed or incomplete contacts may be filled in by working the same station a second time.

(f) Tone reports of T7 or worse count ZERO POINTS.

**Contest Multiplier**

(a) Multiplier for stations outside Europe: Each European call area of the W.A.E. Country List counts ONE Country Point per band. The addition of all countries on all bands results in the multiplier. The W.A.E. Country List of January 1, 1963, is valid.

**QTC Traffic for CW and Phone Sections:**

In order to stimulate versatility and quick reaction among contestants, an interesting phase has been retained in the WAEDC. On a voluntary basis, individual contestants may expand simple messages, I.E. QTC traffic. According to the scoring system below a considerable gain in points can be made.

**What is a QTC?**

1. A QTC is a report of a confirmed QSO which has taken place on any band between a European and non-European station during the contest.
2. A QTC can only be transmitted from a non-European to a European station.
3. A QSO reported in one QTC and confirmed by "O.K." may not be transmitted in a later QTC to another station nor may an identical QTC be transmitted to the same station on a different band. Therefore, the more QSO's which have taken place the more possibilities there are for QTC traffic. The choice of the band for the QTCs is left to the contestant.

**What does a QTC contain?**

1. A QTC contains the time of the original QSO (GMT), the Call sign of the station the QSO had been made with and the received European contact number.
2. Example: 2004/G6Z0/113—This signifies that the original QSO had taken place at 2004GMT with G6Z0 and that it had been the 113 QSO made by G6Z0.
3. A QTC must not be given to the original station, i.e., G6Z0 is not allowed to accept that QTC, but it may be given to another European station.

**QTC Series**

Only a maximum of TEN QTC's per station per band may be accepted by a European station from a DX participant, no matter whether the QTC is passed right after the exchange of the Contest-QSO numbers or at some later time on the same band. This means that several contacts with the same station on the same band are permitted for QTC scoring purposes only.

In order to prevent sending the same QTC twice, it is recommended that the following QTC numbering system be adopted. Example: QTC8/10 means that it is the eighth QTC sent in a series of 10 since the beginning of the contest.

**QTC Traffic Scoring:**

Each QTC for which acknowledgment is received, counts ONE point. Including those on the 3.5MHz band.

**Final Scoring:**

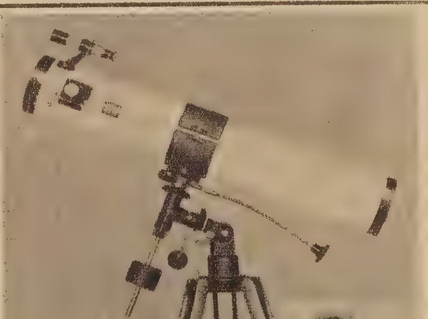
All QSO points—plus the QTC points obtained are added and multiplied by the sum of the country points of all bands to assess the final score.

All contestants must compute their scores. Logs must be checked for duplication. Unscored logs will be used as check logs only.

**Entry Classification:**

Power Input:

| | |
|---|---|
| Class A | up to 50 watts input. |
| Class B | 51 to 150 watts input. |
| Class C | more than 150 watts input. |



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## Receivers For AM/CW/SSB and NOW FM!

### HA-52A 152-174 MC FM

A de-luxe FM Communications Receiver for the Office, Field, or Home.

- 6CW4 Nuvistor "Front-End."
- 3 IF Stages and Fully Tuned RF Stage.
- Excellent Sensitivity of 4 uv or less for 20 db Quieting.
- Built-in Adjustable Squelch for Dependable All-Day Monitoring of Communications Services.
- Built-in 4in Speaker Gives Clear Voice Reproduction.
- Large, Easy-to-read, Slide Rule Dial Illuminated for Night Operation.
- Attractive Blue-Grey Metal cabinet.
- Power Requirements 220/240 V AC.

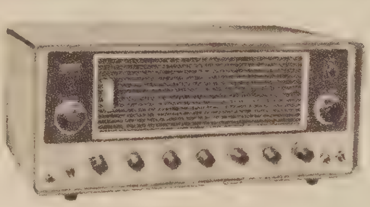
**HA-52A. . . .£49/15/-, $99.50**

### HA-230 9-TUBE AM/CW/SSB

An improved Version of the Popular HE-30.

- 4 Bands 550 KC to 30 MC (includes Broadcast Band).
- 1 RF plus 2 IF Stages.
- Built-in Q-Mulitiplier for Crowded Phone Operation.
- Effective Automatic Noise Limiter.
- Built-in Edgewise S-Meter.
- Calibrated Electrical Bandspread on Amateur Bands 80 to 10 Metres.

**HA-230 .. £79/15/-, $159.50**



### HA-225 14-TUBE SSB/CW/AM

Amateur Receiver With Dual Conversion On Six Metres.

- 5 Bands 150-400KC, 1.6-30MC, 48-54MC.
- Constant Filament Voltage on Mixer and Oscillator Stages Gives Superior Frequency Stability.
- New Product Detector for Improved SSB Reception.
- Crystal Calibrator for Checking Calibrations (Crystal Optional Extra).

**HA-225 .. £119/10/-, $239.00**

### HA-350 X'TAL CONTROLLED 10-80 M. AMATEUR RECEIVER

- An Advanced Receiver of Exceptional Performance.
- Mechanical Filter.
- 12 Tubes Dual Conversion with 100KC Crystal Calibrator and Dual X'tal BFO.
- Product Detector — Selectable Upper and Lower Sideband Reception.
- Complete coverage 80, 40, 20, 15, and 10 Metre Bands. WWV on 15MC.
- Complete with All Crystals (except 100KC Calibrator X'tal Optional).

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WINDSOR SERVICES, Smith Street, Darwin, N.T.

It is necessary to give the exact pow
put in the log and summary sheets.
which do not state the power input
included in Class C.

Entries may be classified as either
operator stations or multiple-operato
ions. Any assistance received in log-k
or operating the station means th
entry must be in the multi-operator
cation.

**Contest Awards:**

No individual will be designated
world-wide winner; however, there
winners named for area. Awards
score in their continents, countries
tricts.

It is necessary to operate for at lea
hours in the contest in order to rec
contest award.

Every participant in the contes
receive a WAEDC Memorial QSL
well as a complete list of the final

**Disqualification:**

Violation of the rules of the cont
unsportsmanlike conduct, or taking
for excessive duplicate contacts
deemed sufficient cause for disqualifi

**Contest Calls**

Stations outside Europe will cal
WAE de." European stations will cal
de" or "DX de" during the contest.

**Contest Reports**

Contest reports must be mailed n
than 15th September for the CW
and 15th October for the Phone
The postmark will determine the
date.

Entries must be sent to:-

The WAEDC Committee of the
DX Bureau, Dr H. G. Todt, D
Chlodwigstr. 5. 1 Berlin 42, Germany.

## YOUTH RADIO SCHE

A very informative and instru
leaflet titled "Your First Radio" ha
made available for distribution to
members throughout the Common
The leaflets, which have been dona
Keith Lane of Transistor Kits, 69A
Street, Brighton, Victoria, give a
good, simple explanation of the op
of a crystal set, together with circu
constructional diagrams. It will no do
of great assistance to the students
mencing their Y.R.S. studies.

The Club at the Sydney Teache
lege has been reformed with a com
new membership for 1966, consisting
Science Graduates studying for Dipl
Education. The 1965 members have a
allocated to Departmental Schools.
Coleman, the 1965 president, has st
club at Meadowbank Boys' High Sch

Reverend Brother D. L. K
VK2AKX, who has been associate
Y.R.S. activities for several years,
delivered a lecture to 30 teaching b
on the advantages of Radio Club
schools. Special emphasis was made
benefits in Geography and Social
by having a school Radio Club trans
station operating on the amateur
Reverend Brother Cyril, has a very
siastic club at the Marist Brother
School, Maitland, N.S.W.

A quantity of Fairchild transist
been made available and dist
to Y.R.S. clubs. These transistors ha
distributed to all Y.R.S. member
gained Junior Certificates and higher a

An interesting note appears
N.S.W., Y.R.S. Newsletter. It refer
letter received from Robert L. Wo
Consultant in Industrial Arts Ed
State Department of Education, Cal
A section of the letter reads:

"Many of the school districts i
fornia encourage their teachers in t
of industrial arts education to obtai
amateur radio licenses and set up a
radio stations in their schools.

"Often provisions are made dur
school day or after school for stud
both the junior high school level a
school level to study and practice f
amateur radio licenses."

# 966 REMEMBRANCE DAY CONTEST

amateur operators in Australia are invited
ticipate in this annual contest which per-
es the memory of amateur operators who
neir lives while serving their country in
War II.

annual contest is restricted to amateur
ors within the Commonwealth of Australia
erritories. It is unique in as much as
is no individual winner, as it is a con-
etween the State divisions of the Wirless
te of Australia. The trophy is held by
nning division but certificates are awarded
highest scorers in each division. Non-
ers of the institute may participate and
scores are included in the total for the
n in whose State they reside.

determine the greatest possible score to
ned by each division, it is necessary for
contestant to enter a scoring log for the
n in which he is licenced.

the 1966 Federal convention, the Federal
of the institute agreed to a change in
ethod of computing the final scores of
ivisions. However it was not possible
the time available between the close of
nvention and the publication dates to draft
cessary amendments to the rules.

ussion also took place on possible ways
ich the scores of limited licensees partici-
in section "E" introduced in 1965, could
luded in the overall score of their divi-
Further suggestions on methods that
be considered should be sent to the Fed-
Contest Committee. There are however
minor changes to the rules which governed
65 contest.

perpetual trophy awarded annually for
tition between divisions, is inscribed with
mes of those who made the supreme sacri-
d so perpetuates their memory throughout
r radio in Australia.

name of the winning division each year
inscribed on the trophy and in addition
nning division receives a suitably inscribed
ate.

TS:

teurs in each Call Area including Aus-
Mandated Territories and Australian An-
will endeavour to contact amateurs in
Call Areas. In addition, amateurs will
our to contact any other amateurs on the
sed bands above 52MHz (i.e. intrastate
ts will be permitted on the VHF/UHF
.

EST STATE:

0 hrs. GMT Saturday, August 13, 1966,
9 hrs. GMT Sunday, August 14, 1966.

amateur stations are requested to observe
nutes' silince before the commencement of
ontest on the Saturday afternoon. An
riate broadcast will be relayed from all
nal stations during this period.

:

There shall be five sections to the contest:
a) Transmitting Phone;
b) Transmitting CW;
c) Transmitting Open;
d) Receiving Open;
e) Transmitting Open—VHF/UHF only.

All Australian amateurs may enter the
t whether their stations are fixed, portable
bile. Members and non-members will be
for awards.

All authorised amateur bands may be
and cross-mode operation is permitted.
band operation is not permitted.

Amateurs may operate on both phone and
uring the contest, i.e. Phone to Phone,
o CW, or Phone to CW. However, only
ntry may be submitted for sections (a) to
Rule 1. A separate entry may be
ted for section (e) in Rule 1.

open log will be one in which points
aimed for both Phone and CW transmissions.
to Rule 11 concerning log entries.

For scoring only one contact per station
and is allowed. However, a second scoring
t can be made on the same band using
lternate mode. Arranged schedules for
ts on other bands are prohibited.

Multi-operator stations are not permitted.
gh log keepers are permitted, only the
d operator is allowed to make contact
his own call sign. Should two or more
to operate any particular station, each
e considered a contestant and must submit
arate log under his own call sign. Such
tants shall be referred to as "substitute
ors" for the purposes of these Rules and
operating procedure must be as follows:
ne: Substitute operators will call "CQ RD"
Q Remembrance Day" followed by the call of
tation they are operating, then the word
followed by their own call sign, e.g. "CQ
ance Day from VK 4BBB log VK 4BAA."
: Substitute operators will call "CQ RD de"
ed by the group call sign comprising the
the station they are operating, an oblique
stroke and their own call, e.g. "CQ RD de VK 4BBB/VK4BAA."

Contestants receiving signals from a substitute operator will qualify for points by recording the call sign of the substitute operator only.

7. Entrants must operate within the terms of their licences.

8. Ciphers — Before points may be claimed for a contract, serial numbers must be exchanged and acknowledged. The serial number of five or six figures will be made up of the RS (telephony) or RST (CW) reports plus three figures, that will increase in value by one for each successive contact. If any contestant reaches 999, he will start again with 001.

9. Entries must be set out as shown in the example, using ONLY ONE SIDE of the paper and wherever possible, standard W.I.A. Log Sheets should be used.

Entries should be clearly marked "Remembrance Day Contest, 1966" and must be postmarked not later than September 5, 1966. Address them to Federal Contest Manager, W.I.A., G.P.O. Box N1002, Perth, W. Aust. Late entries will be disqualified.

10. Scoring will be based on the table shown. A bonus of 25 points may be claimed for the first contact with other call areas on each of the bands 52MHz and above.

In addition, all intrastate contacts on bands 52MHz and above are worth 1 point each.

Portable Operation: Log scores of operators working outside their own Call area, will be credited to that Call area in which operation takes place: e.g. VK5ZP/2. His score counts towards N.S.W. total points score.

11. All logs shall be set out as in the example shown and in addition will carry a front sheet showing the following information:

## EXAMPLE OF TRANSMITTING LOG

| DATE/ TIME GMT | BAND | EMISSION AND POWER | CALL SIGN WORKED | RST No. SENT | RST No. REC'D. | V.H.F. BONUS | POINTS CLAIMED |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

## EXAMPLE OF RECEIVING LOG (VICTORIA S.W.L.)

| DATE/ TIME G.M.T. | BAND | EMISSION | CALL SIGN HEARD | RST No. SENT | STATION CALL | V.H.F. BONUS | POINTS CLAIMED |
|---|---|---|---|---|---|---|---|
| Aug. 1966 | | | | | | | |
| 14 0810 | 7MHz | A3(a) | VK5PS | 58002 | VK6RU | — | 2 |
| 14 0812 | 7MHz | A3(a) | VK6RU | 59007 | VK7EJ | — | 5 |
| 14 1035 | 52MHz | A3 | VK4ZAZ | 56010 | VK5ZDR | 25 | 28 |
| 14 1040 | 52MHz | A3 | VK3ALZ | 59025 | VK3QV | — | 1 |

NAME..............................
ADDRESS..............................
..............................
SECTION..............................
CALL SIGN..............................
CLAIMED SCORE..............................
No. OF CONTACTS..............................

Declaration: I hereby certify that I have operated in accordance with the Rules and spirit of the Contest.

SIGNED ..............................
DATE.................

All contacts made during the Contest must be shown in the log submitted (see Rule 4). If an invalid contract is made it must be shown but no score claimed.

Entrants in the Open Sections must show CW and phone contacts in numerical sequence.

12. The Federal Contest Manager has the right to disqualify any entrant, who, during the Contest, has not observed the regulations or who has consistently departed from the accepted code of operating ethics. The Federal Contest Manager also has the right to disallow any illegible, incomplete or incorrectly set out logs.

13. The ruling of the Federal Contest Manager of the W.I.A. is final and no disputes will be discussed.

**AWARDS:**

Certificates will be awarded to the top-scoring stations in sections (a) to (c) of Rule 1 above, in each call area. VK1 and VK8 will count as separate areas for awards. There will be no outright winner for Australia. Further certificates may be awarded at the discretion of the Federal Contest Manager.

The Division to which the Trophy will be awarded shall be determined in the following way.

To the average of the top six logs shall be added a bonus arrived at by adding to this average the ratio of logs entered to the number of State Licensees (excluding limited licensees) multiplied by the total points from all entries in sections (a), (b) and (c) of Rule 1.

Average of top six logs plus

$$\frac{\text{No. of Logs entered}}{\text{No. of State licensees (excluding limited licensees)}} \times \text{Total points from all entrants in sections (a), (b) and (c)}$$

VK1 scores will not be included with VK2 nor VK8 with VK5.

Acceptable logs for all sections shall show at least five valid contacts.

The trophy shall be forwarded to the winning Division in its container and will be held by that Division for the specified period.

**RECEIVING SECTION:** Section (d) Additional Notes:

1. This section is open to all short wave listeners in Australia, but no active transmitting station may enter.

2. Contest times and logging of stations on each band are as for transmitting.

3. All logs shall be set out as shown in the example. The scoring table to be used is the same as that used for transmitting entrants and points must be claimed on the basis of the State in which the receiving stations are located.

A sample is given to clarify the position.

It is not sufficient to log a station calling C.Q.—the number he passes in a contact must be logged.

It is not permissible to log a station in the same call area as the receiving station on the MF and HF bands 1.8-30MHz but on bands 52MHz and above such stations may be logged, once only per band, for one point. See example given. VK1/VK2 and VK5/VK8 are considered to be the same area for scoring purposes.

4. A station heard may be logged once on phone and once on CW for each band.

5. Club receiving stations may enter for the receiving section of the contest, but will not be eligible for the single operator award. However, if sufficient entries are received a special award may be given to the top receiving club station in Australia. All operators must sign the Declaration.

**AWARDS:**

Certificates will be awarded to the highest scores in each call area. Further certificates may be awarded at the discretion of the Federal Contest Manager.

**TRANSMITTING OPEN — VHF/UHF ONLY SECTION (Section E).**

**ADDITIONAL NOTES:**

1. This section was introduced last year in answer to the request by many amateurs that provision be made for the participation by limited licencees and other VHF/UHF operators. It is in the nature of an experiment and because of this, logs entered for section (e) at this juncture, will not be considered in the determination for the trophy winner. In the light of future experience response to this section by those it is intended to interest, and comments from all interested parties, other additions and changes may be made.

2. All intrastate contacts in the bands above 52MHz will count for one point. Interstate contacts will be valued as in the table for MH/HF contacts including the bonus 25 points for the first contact with each new call area.

3. Entrants may submit logs for one transmitting section other than (e) and interstate VHF/UHF contacts may be included in both logs.

4. Logs must be set out in the standard manner prescribed.

**AWARDS:**

Certificates will be awarded to the highest scorer in each call area. NOTE 1: The Federal Contest Manager emphasises the need for strict observance of Rule 9 in the transmitting section and Rule 3 in the receiving section.

NOTE 2: Note that the use of GMT is required in accordance with institute policy to encourage the use of GMT by Australian amateurs.

## SCORING TABLE

| To | VK0 | VK1-2 | VK3 | VK4 | VK5-8 | VK6 | VK7 | VK9 |
|---|---|---|---|---|---|---|---|---|
| From VKO | - | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| " VK1-2 | 6 | - | 1 | 2 | 3 | 5 | 4 | 6 |
| " VK3 | 6 | 1 | - | 3 | 2 | 5 | 4 | 6 |
| " VK4 | 6 | 1 | 2 | - | 3 | 6 | 5 | 4 |
| " VK5-8 | 6 | 2 | 1 | 3 | - | 5 | 4 | 6 |
| " VK6 | 6 | 1 | 2 | 4 | 3 | - | 5 | 6 |
| " VK7 | 6 | 2 | 1 | 4 | 3 | 5 | - | 6 |
| " VK9 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | - |

**NOTE: Read table from left to right for points for the various call areas.**

**A. C. E.**
AMPLIFICATION
COMMUNICATION
ELECTRONICS

★★★★★★★★★★★★★★★★★★★★★★PHONE 51-38

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AND 636 KING STREET, NEWTOWN—51-7008

## 136 VICTORIA ROAD, MARRICKVILLE — 51-3845

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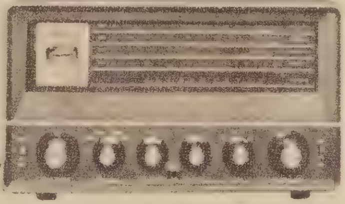
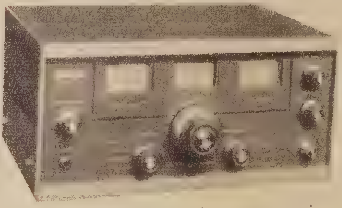


7 Valve. 4 Band. 550 K.C. to 31 Megs. A.M. and C.W. Bandspread. A.N.L. B.F.O. A.V.C. M.V.C. S Meter. R.F. Stage. 240 V. 50 Cycle.

**$99.00 £49/10/-**

Also available in kitset $89.00 £44/10/-

### 9R59D. SIDEBANDER

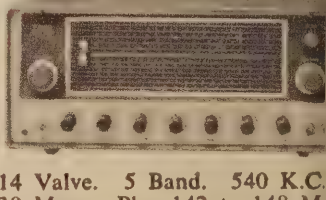


**MECHANICAL FILTER**

9 Valve. 4 Band. 540 K.C. to 30 Megs. Electrical Bandspread. A.N.L. A.V.C. M.V.C. S Meter. B.F.O. 1-R.F. Stage. 2-IF Stage. Stabilised Osc. For SSB.

**$159.50 £79/15/-**

### J.R. 60 PRO-AM & S.S.B. V.



14 Valve. 5 Band. 540 K.C.
30 Megs. Plus 142 to 148 M
Double Conversion. Electr
Bandspread. Variable Selectiv
Q Multiplier. A.M. C.W. S
F.M. Crystal Calibrator. A.
A.V.C. B.F.O. Product Detec
Gated Beam. F.M. Det.

**$215.00 £107/10/-**

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### W-41U

9 valves. 20 watts. 20-20,000 cycles per channel. Input for tape. Mag. and crystal P.U.

**$110.00 £55/-/-**

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7 valves. 12 watts per channel. Input for tape. Mag. and crystal P.U. Direct coupled circuit. 20 to 20,000 cycles. Within ½ D.B.

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Locked crystal. Low noise casc circuit.

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### W-26 STEREO TUNER AMPLIFIER

12 Watts per Channel. Dual Wave. Inputs for Tape, Magnetic and Crystal Pick-up. Tape Recorder facilities.

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### T.K. 400E SOLID STATE 26 TRANSISTOR 80 WATT STEREO

**240V A.C.** **40 WATT PER CHANNEL**

Inputs: Phono. Mag. 1½ MV, Tape 1½ MV, Phono. Cryst. 80 MV, Tuner 100 MV, Aux. 100 MV.

Freq. Res.: 20-20.000 plus/minus 1dB.

Controls: Bass, Treble, Loudness, Balance, Separation. $178 £89

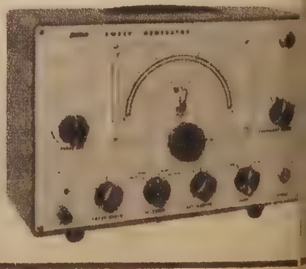
VALVE TYPE, AS ABOVE, TK500E. 90 watt output.

**$170 £85**

### TRIO W.0.1 SWEEP GENER

TV and F.M. 2 to 260 M
Sweep 0 to 20 Meg. Ideal for
Sound and Picture Aligning

**$99.00 £49/10/-**



★★★★★★★★★★★★★★★★★★★★PHONE 51-3845

A. AMPLIFICATION
C. COMMUNICATION
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# RADIO

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K
0
330

K
20
CT500

## 220S 4000 O.P.V.

. Volts 5, 25, 125, 500, 2500.
, Volts 10, 50, 250, 1000.
rent: 250uA, 250mA.
stance: 0-10K, 0.1 Meg.

**£3/19/6 Post 5/-**

## C.T.330 20K.OPV

. Volts, 6, 6, 30, 120, 600, 1200,
, 6000. A.C. Volts, 6, 30, 120,
1200. D.C. Current, .06-6, 60,
nA. Resistance, 6K, 600K, 6meg.
eg. D.B, minus 20 to plus 62.
Ranges. Specially suitable for
sistor use. **$15.95** Post., 50c.

## C.T.500 20K.OPV

, Volts, 2.5, 10, 50, 250, 500,
, A.C. Volts, 10, 50, 250, 500,
. D.C. Current, .05, 5.50,
nA. Resistance, 12K, 120K,
meg., 12meg. D.B. minus 20 to
62.

**$13.25** Post., 50c.

## KAMODEN 370N

100 K. Ohm per volt.
. volts. 100Mv. 2.5V. 10V.
V, 250V, 1Kv. 5Kv. A.C. volts.
, 10V. 25V. 100V. 250V. 1Kv.
. Current 10 Micro. 100 Micro.
I.A. 10 M.A. 100 M.A. 1 Amp.
Amp. Ohms. 5K. 50 K. 500 K.
leg. 50 Meg. D.B. —20 to +62.

**$28.75**

N.S.W., 75c; Interstate $1.50.

## P.T.34 1000.OPV

. Volts, 0, 10, 50, 250, 500, 1000.
. Volts, 0, 10, 50, 250, 500 1000.
M.A. 1-100-500 RESISTANCE.

**$5.25** Post., 50c.

## 200H. 20K.OPV

. Volts, 5, 25, 50, 250, 500,
. A.C. Volts, 10, 50, 100, 500,
. D.C. Current, 50uA, 2.5,
nA, Resistance, 6K, 600K.
acitance, 2 D.B. Ranges.

**$10.50** Post., 50c.

. PRICES NET, INC. S.-TAX.

## T.E. 40. V.T.V.M. MILLIVOLTER

Ranges, 1 MV to 300 V RMS.
Ranges, D.B. minus 40 to plus 50 DBM.

**$44.50**

## V.T.V.M.

27 Ranges, A.C. Powered.
.V. 0, 1.5, 5, 15, 50, 150, 500, 1,500.
.V. 0,1.5, 5, 15, 50, 150, 500, 1,500 R.M.S.
V. P. to P. 0, 1.4, 4, 14, 40, 140, 400, 1,400, 4,000.
stance, 1 ohm to 1,000 megohm.
Minus 10 D.B. to plus 65 D.B.

**$42.50**

Post., $1.
I.V. Probe to 30 KV, $7.75.
T.M.K. Units, $53.50.

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## WIDE BAND OSCILLOSCOPE

5 Meg. Bandwidth. Push-pull vertical and horizontal Amplifiers. 8 position, high sensitivity vertical Amplifier, Frequency Compensated on all positions. Calibrated .02 to 600 volt. Hard-time base, 20 cycles to 75K. Latest American R.C.A. circuitry. Complete with probe.

**3-inch $99.75; 5-inch $111.50**

T.O.2 TV portable service unit 2" oscilloscope $59.50.

## 4 CHANNEL MICROPHONE MIXER PRE AMPLIFIER

**$7.75**

Post., 50c.

## TRANSISTORISED VARIABLE POWER SUPPLY

Range to 20V, 200MA

**$18.75**

Post., 50c.

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Leader, 810, 6-Band, 2 Meg. to 260 Meg. Nuvistorised, 240 V.A.C. Operation, Modulated, Calibration. Accuracy 2 per cent.

**$41.50**

T.E. 18 Lafayette, 8 Bands, 360 K.C. to 260 Megs. 240 V.A.C. operation.

**$39.50**

Post., N.S.W., 50c; Interstate, 75c.
T.E, 15 Transistorised, 7 Band, 360 Kc to 270 Megs.

**$34.75**

## PANEL METERS

## EDGE TYPE

1 mM. Scaled, S. Meter, Stereo Balance. Tuning. **$2.50**

## 2" 3" 4" PLASTIC COVERED PANEL UNITS

Latest P series ¾in Barrel 50mmA, 200mmA. 1mA, 10 mA, 500mA, 1 Amp, 10 Amp, 15V. 500V. **From $3.00**

## MINILAB 7in 1 MULTIMETER

**$16.75**

Post, 50c.

## STEREO PRE AMPLIFIER

240 V. A.C. Power.
To suit magnetic P.U. tape or microphone.
Response: 20 to 20,000 cycles.
Gain 60 D.B.

**$15.50**

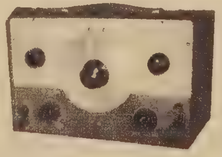
Post., 50c.

## LEADER SWEEP & MARKER GENERATOR SMG 532

TV and F.M. 2 to 270 Megs. 5.5 Meg. Crystal for TV sound. Sweep width to 12 Megs. Model 531.

**$170.00 £85/-/-**

Post., N.S.W. $1.50; Interstate, $2.50



## T.E. 20 RF SIGNAL GENERATOR

Freq. 120KC—260MCS in 6 bands.
Output (RF)—High 100,000uV max.
Low 100uV max.
Output (Audio)—400 cps approx. 8V.
Modulation — 400 cps internal.
Operation — 240V AC.
Dimensions 7in x 10½in x 5½in.
Weight — 9lb.
Complete with Instruction Book circuit.

**$24.50**

T.E. 20D, sig and marker gen.
120KC to 500 megs.

**$25.50**

Post., N.S.W., 75c; Interstate, $1.25.

## LEADER SIGNAL GENERATOR LSG 11

240v A.C. Powered.
6 Band, 120 Kc to 390 Megs.
Provision for Crystal.
An Ideal TV Marker Generator.

**$29.50**

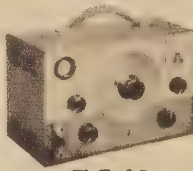
Post., N.S.W., 75c; Interstate, $1.25.

## SIGNAL INJECTOR

Transistorised. Fountain Pen-sized Unit for Signal Tracer in Radio, TV and Amplifier Service.

**$4.75**

Post., 25c.



## T.E.46 RESISTANCE-CAPACITANCE

Bridge and Analyser.
Capacity 20 pfd to 2,000 mfd.
Resistance 2 ohm to 200 megs.
Also tests power, factor, leakage, impedance, transformer ratio, insulation resistance to 200 megs. at 600V.
Indications by eye and meter.

**$43.50**

## T.E.22 AUDIO GENERATOR

Sine and Square Wave.
20 Cycles to 200 K.C. 4 Bands.
Frequency response plus/minus 1.5 D.B.
60 Cycles to 150 K.C.
Output impedance 5,000 ohm.
Output volts, 0 to 7.

**$36.50**

**T.E. 22D $37.50**

T.C.
2

## VALVE TESTER

Tests all valves, diodes, rectifiers, checking filaments, shorts. Merit on direct reading. Good-bad meter. Complete with tube chart.

**$26.75**

Post., N.S.W., 25c; Interstate, $1.25.

**T.E. 50.—99—5011**

Checks. Nu Vistas, Compactrons, etc.

**$34.25**

**A. AMPLIFICATION**
**C. COMMUNICATION**
**E. ELECTRONICS**

PHONE 51-38

# RADIO

636 KING STREET, NEWTOWN—51-7008

## 136 VICTORIA ROAD, MARRICKVILLE — 51-3845

### B.S.R.

4-TRACK DECK
$35.50 £17/15/-
2-Track, 3-Speed.
$35.50 £17/15/-
4-Track, 3-Speed. Mono or Stereo.
$45.25 £22/12/6
4-TRACK. 3-SPEED.
3 HEADS.
$49.50 £24/15/-

BRADMATIC HEADS
Latest ½-Track. Hi Fi.
$9.50 £4/15/- pair

**4-TRACK or STEREO**
Record play back $11.50
erase $5.50

### THE NEW COLLARO TAPE DECK

Takes 7in spool.
3 speeds: 1⅞, 3¾, 7½ i.p.s.
2-track, $44.
4-track, $48.
Write for particulars.

### TRANSISTOR POWER SUPPLIES

12v. D.C. Input. 300v. 150Ma. Output plus 150v. Output.
$23.75 £11/17/6
12v. D.C. Input. 400v. 150Ma. Output plus 200v. Output.
$29.75 £14/17/6

240v. A.C. INPUT
9V. 200 M.A. $4.75
4.5V. 6V. 9V. 12V. 200 M.A. $5.75
9V. 12V. 15V. 22V. 500 M.A.
$7.75
Post: N.S.W., 50c; Interstate 75c.

### VARY. A.C.S.

240-270V 50 cycle 5 amp.
Provide infinitely variable AC voltage
$29.50 £14/15/-
2½ Amp as above
$23.50 £11/15/-
10 amp. as above.
$45.75

### PLAYMASTER 106 AND 107

Feb. and March Elect. Aust.
106
WIRED AND TESTED, $88.75
107
WIRED AND TESTED, $79.00

### TRANSISTOR RECORD PLAYER

Portable. 2-speed. Moulded Cabinet
$29.75
A.C. Power Supply if required to suit this unit. $4.75.

### Transistor-Ignition HI-SPARK

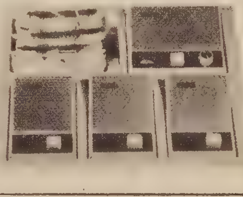
Simple installation.
38 K.V. output.
Complete. Tested.
Negative earth.
$33.50 £16/15/-
Positive earth.
$41.50 £20/15/-
State voltage and polarity.
Post., N.S.W., 75c; Interstate, $1.25.

### CITIZENS BAND

27.240 Megs.
10 Transistor Transceivers.
100 M.W. output.
$45.00
1. Watt 13 Transistor 1 channel with squelch.
$65.00 each (£32-10-0)
1 watt. 15 transistor, with squelch provision for two channels. Range to 10 miles under ideal conditions.
$80.00 £40 each

### INTER. COM. UNITS

2 Station Transistorised
$11.50 £5/15/-
4 Station, including Master
$20.25 £10/2/6



### New Telephone Amplifier

Transistorised.
$11.50 £5/15/-
Post 35c.

### T.V. TUNERS

New 10-channel Tuners.
$15.00 £7/10/-
Post 75c.

### LATEST 4-SPEED PLAYERS

| | |
|---|---|
| 240V A.C. Mono | $11.50 |
| 240V A.C. Stereo | $17.00 |
| Battery Mono | $19.50 |
| Battery Stereo | $21.50 |
| Battery Mono 45 r.p.m. in Cabinet | $9.25 |

Post., N.S.W., 75c; Interstate, $1.25.

### ELECTRIC GUITAR

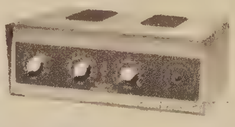
| | |
|---|---|
| Pickup Units | $8.75 |
| Accordion Pickup Units | $8.75 |
| Harmonica Pickup Units | $1.95 |

Post., N.S.W. 40c; Interstate, 75c.

*Send for full details on Radiogram Chassis, TV and Amplifiers.*

### AMPLIFIERS

Public Address Range
240V-AC



**MINIATURE P.A. AMPLIFIER. 15 WATTS OUTPUT.**

| | |
|---|---|
| Multi Match Ferguson O.P. transformer input for crystal mike and pick-up with electronic mixing, P.P. EL.84 output | $39.50 |
| 30 Watt, As above EL34 P.P. | $53.50 |
| 40 Watt, As above EL34 P.P | $79.50 |
| 60 Watt. As above EL34 P.P. | $98.50 |

LINE OR VOICE COIL TRANSFORMERS.
MULLARD HI-FI RANGE.

| | |
|---|---|
| 5/10 with pre amp base and treble boost. Ultra Linear output | $43.50 |
| 5/20in. As above | $65.50 |

### BATTERY-AC OPERATION

| | |
|---|---|
| 6 valve 6v plus 240v-10 watt | $55.50 |
| 7 valve 12v plus 240v-12 watt | $59.75 |
| 7 valve 12v plus 240v-25 watt | $71.75 |

### TRANSISTOR P.A. AMPLIFIER C.A.-512

12VDC Operation.
Output 20 watts.
Current consumption at max. output, 2.2 amps.
Input. High imp. mic. Also 600 ohms and tape.
Independent gain controls.
Output: Imp. 4-8-16 ohms.
Freq. Response:
200 cps—6000 cps.
Dimensions: 2in x 6¼in x 8½in.
Complete with instruction book with circuit. All plugs.
PRICE $57.50

### DYNAMIC MICROPHONES

| | |
|---|---|
| DM-391 HI-Imp | $3.50 |
| DM-175 HI-Imp | $4.75 |
| DMS-3 HI-Imp | $5.50 |
| DM-305. 600 ohms or HI-Imp. Suitable stand mounting | $9.75 |
| DM-304. Dynamic Cardioid. 50 ohms or HI-Imp. Suitable stand mounting | $15.75 |
| D.M. 307 HI-IMP. | £7/10/- |
| CM-10 Crystal HI-Imp. Suit stand mount. | $5.06 |

Post., N.S.W., 25c; Interstate, 35c.

### WIDE RANGE LIGHTWEIGHT STEREO PICK-UPS

| | |
|---|---|
| Ceramic Units, Sapphire Styli | $ |
| Diamond Styli | $1 |
| Universal Ceramic Stereo Cartridge, Sapphire Styli | $ |
| Diamond Styli | $ |

### NEW WIDE RANGE SPEAKERS

15 ohm. Twin Cone

| | |
|---|---|
| 8in | $ |
| 12in | $ |
| 5in | $ |
| 5in Tweeter | $ |
| 4in Single Tweeter | $ |
| 12in Heavy Duty 20 watt | $1 |

### P.A. REFLEX HORN

WITH UNITS

| | |
|---|---|
| 5 Watt 8 ohm | $1 |
| 10 Watt 8 ohm | $2 |
| 35 Watt 15 ohm | $1 |

N.B.: As these are American rat divide the wattage by 2.

### STEREO RECORD CHANGERS

1965 model. 4-speed.
$21.50 £10/15/-
De Luxe Model.
Fully machined and balan Heavyweight turntable. Cer cartridge.
$27.50 £13/15/-
Post. N.S.W., $1.25; Interstate, $

### STEREOPHONIC HI-HEADPHONES

With padded earpieces
SPECIFICATION:
Frequency Response: 25-17,000
Nominal Power 1 watt.
V.C. Imp. 8 ohms each cha
$7.75 £3/17/6
Post., 50c.

### PHILIPS DISC JOCKEY

4-speed Players.
6V, D.C. OPERATION.
MONAURAL CRYSTAL HE
$9.75 £4/17/6
STEREO
$11.75 £5/17/6
Post., N.S.W., 75c; Interstate, $

### MORSE KEYS

New lightweight, fully adjustable
$1.25
As above with buzzer.
Complete Morse practice set
$1.65

A. AMPLIFICATION
C. COMMUNICATION
E. ELECTRONICS

★★★★★★★★★★★★★★★★★★★★★ PHONE 51-3845

# RADIO

636 KING STREET, NEWTOWN—51-7008

## 136 VICTORIA ROAD, MARRICKVILLE — 51-3845

## GUITAR AMPLIFIERS

att, Two Channel, with Twin
Speaker, $51.50 (£25/15/).

att, 4 Inputs, Bass and Treble
t. 2 Twin Cone Speakers,
0 (£29/15/).

att. Four-Channel. Bass and
le Boost. Two Twin Cone
kers, $73.75 (£36/17/6).

### 35 WATT

nnel, Bass and Treble Boost.
Twin Cone Speakers, $105
/10/).

60-Watt, 2 Unit
-12in Auditorium Speakers,

**71.75 £85/17/6**

ato with foot control and 2
et controls for frequency and
sity. $10.56 (£5/5/) extra on
e models.

### 4 plus 14 WATT

Reverberation. May be used
Watt or as 14 Watt plus 14
Reverb. Two 9 x 6 Woofer
kers. Two 9 x 6 Twin-Cone
kers. 4 Channels. Bass and
le Boost. Foot Vibrato Control
ded.

**$163.50 £81/15/-**

P BASS OR BASS GUITAR
40 WATT AMPLIFIER

put Channels. Bass and Treble
t. Two 12in Radial Beam
kers. Perfect reproduction on
ycles.

**$145.75 £72/17/6**

### PIGGY BACK UITAR AMPLIFIER

| | |
|---|---|
| Vatt .. .. .. .. .. | $79.75 |
| Vatt .. .. .. .. | $99.75 |
| Vatt . .. .. .. | $119.75 |

puts. Bass and Treble Boost.
ato if required. $10.50 extra.

### APE ECHO UNIT

Suits any Guitar amp.
without any alteration.

JUST PLUG IN

**$139.50**

### REVERBERATION PRE AMPLIFIER

Suits any Guitar amp.
No changes necessary.

JUST PLUG IN

Completely transistorised.

**$58.75**

## PLAYMASTER 4 STEREO AMPLIFIERS

Push-Pull. 8 Watt per Channel. Bass and Treble boost and Cut.

Wired and Tested.

**£38/10/- $77.00**

### T.V. SIGNAL-BOOSTER

240 V. operation. No change. To set. Simple connection. Extra gain on all channels.

**$9.75**

Post 50c.

### NEW RECORDING TAPE

| | £ | s | d |
|---|---|---|---|
| 3in. Mylar LP 300ft. .. | | 10 | 6 |
| 5in. Mylar LP 900ft. .. | 1 | 0 | 0 |
| 5in. Mylar DP 1200ft. .. | 1 | 5 | 0 |
| 5¾in. Mylar LP 1200ft... | 1 | 5 | 0 |
| 5¾in Mylar DP 1800ft | 1 | 17 | 6 |
| 7in. P.V.C. 1200ft. .. | 1 | 5 | 0 |
| 7in. Mylar LP 1800ft. .. | 1 | 17 | 6 |
| 7in. Mylar DP 2400ft. .. | 2 | 10 | 0 |
| 10½in. Mylar LP 3600ft. . | 3 | 15 | 0 |

Post 2/6 per Spool.

### P.A. SPEAKERS
8 WATT

8in. Units in Waterproof Projection Horns.
15 Ohm Voice Coils.

**$13.50 £6/15/-**

In Double Ended Flares, Duolateral Coverage.

**$14.50 £7/5/-**

Line Output Transformers to suit, $1.75 (17/6) extra.

### P.A. SPEAKER DRIVER UNITS

American Rating. 30 Watts, Voice Coil 16 ohm.

**$21.50 £10/15/-**

15 Watt Rating.

**$15.75 £7/17/6**

REFLEX HORNS TO SUIT.

**$21.50 £10/15/-**

*WEEKEND — HOLIDAY — EVENING*
*DEMONSTRATIONS AT COLLAROY*

PHONE XW5956 FOR APPOINTMENT TO TEST STEREO GUITAR AMPLIFIERS AND TELEVISION.

## BATTERY CHARGER

240 Volt A.C. Operation

3 Rate 6V, 12V TRICKLE CHARGE

Trickle Charge Position suits all Batteries. 2V to 12V at rate of 200 to 500 M.A.

| STANDARD | | DE LUXE | |
|---|---|---|---|
| 2 amp. 6V, 12V, TRC .. | $11.50 | 1½ amp., 6V-12V .. .. | $9.75 |
| 3 amp. 6V, 12V, TRC .. | $12.25 | 3 amp. .. .. .. .. .. | $16.75 |
| 4 amp. 6V, 12V, TRC . | $15.25 | 4 amp. .. .. .. .. .. | $19.75 |
| 5 amp. 6V, 12V .. .. . | $15.95 | 6 amp. .. .. .. .. .. . | $21.75 |
| | | 10 amp. .. .. .. .. .. | $27.75 |
| Post., N.S.W. 75c, Interstate $1.25 | | Rail or Air Freight on. | |

## MULLARD MAGNAVOX

*BOOKSHELF ENCLOSURE*

**Maple, Teak or Walnut**

**Complete $26.00**

Post: N.S.W. 5/-. Interstate 10/-.

REVERBERATION UNIT
ACE RADIO MARRICKVILLE
INPUT
OUTPUT

## REVERBERATION UNITS

Latest design to suit organs, stereo, guitar, any hi-fi equipment.

**£2/17/6 $5.75**

Post. 3/6.

### ELEGA REVERB. SPEAKERS

Automatic addition of reverberation to any existing amplifier.
Handles 12 watts.

**£12/15/- $25.50**

### CO-AXIAL SPEAKERS C.S-30. 12"

V.C. 16 ohm. Cross over 3,000 cycle. Frequency range 30 to 20,000 cycles. Rated 20 watts.

**£13/19/6 $27.95**

### C.S-20. 8"

V.C. 16 ohm. Cross over. 3,000 cycle. Frequency Range 40 to 20,000 cycles. Rated 8 watts.

**£7/19/6 $15.95**

### HORN TWEETER CT-3

2,000-20,000 Response.
20 Watts Power.
Sensitivity 110 dbw.
Weight 1¾lb.

**£4/9/6 $8.95**

### MULLARD-A.C.E. TACHOMETER

Wired and tested.

**$20.75 £10/7/6**

"Electronics Australia," July, August issue. State max. revs., voltage, polarity cylinders.

METER ONLY

**$6.75 £3/7/6**

INCLUDING DWELL. ANGLE FACILITY

**$23.25 £11/12/6**

Post., N.S.W., 50c; Interstate, 75c.

# LISTENING AROUND THE WORL

**Art Cushen's monthly report on long-distance short-wave, television and broadcast band reception.**

## World-wide Service from Radio Vienna

The Austrian Radio has ended its long series of test transmissions, and now is operating a world wide service from its studios in Vienna.

The signals from Radio Vienna are well received in a service to India-Indonesia when using 17855KHz. The signals are best on a Sunday night and light music is played with German announcements from 0530 to 0600GMT when the announcements in German, French and English are given. The English announcement states that the frequencies of 6155 and 7245KHz are carrying the program to Europe, and the frequencies of 15410 and 17855KHz are beamed to listeners in India and Indonesia.

The best reception is on 17855KHz, which is indeed strong for a European signal at this hour. The other channel of 15410KHz suffers interference from stations on a nearby frequency. Reports are requested to be sent to Radio Vienna, Vienna, Austria. Verification is by a card, generally sent by airmail.

The recent changes in the Vienna schedule have come about by the ending of the long period of test transmissions and the commencement of specific services to various parts of the world. These services from Vienna have also been noted. The transmission 0900-1100 to Europe is on 6155 and 7245KHz; to Australia and New Zealand on 17755KHz also on the air 0900-1100GMT; 1500-1700 the transmission is for Europe, on 9770 and 11785KHz, and for South Africa on 17750KHz which is carrying the same transmission.

The Vienna station has been on a test basis for two years or more. The program has been a relay of the Home Service, the announcements of location and frequency being given in German, French and English, with request for reports from listeners.

### AFRICAN SIGNALS

Australian readers are enjoying some excellent reception in the 60M band of signals from the African area. Bob Padula of Melbourne supplies a list of some of these signals which should continue to be heard by listeners in Australia for the next few weeks, though the times of reception would be at a slightly earlier hour, due to the end of the mid-winter reception period and the general decrease of daylight reception.

Angola station CR6RW on 5033KHz is heard at 2200 with Portuguese programs, and interference is noted from the Central African Republic station on 5037 KHz until this station closes at 2230GMT. Nigeria's National Service from Lagos station using the frequency of 4990KHz, has news in English at 2200GMT. The Ivory Coast station on 4940 is heard at 2200GMT when it has programs relayed from the home service in French.

Spanish Guinea station on 4926KHz is heard at 2100 when it has a relay of news from Spanish National Radio, Madrid. All the programs from this station are in Spanish. Two Cameroon stations are being heard; one of them uses 5010KHz and is heard with good signals at 2200GMT sign off in French; while on 4972KHz another station is heard at the same time. Home programs from Upper Volta on 4815KHz are noted at 2230 with sideband interference from Radio Angola, using 4820KHz. English from Radio Ghana in Accra is on 4980KHz, heard at 2200GMT. Radio Ghana also has a French transmission. This is on 4915KHz, and is also heard at 2200GMT.

### RADIO SOUTH AFRICA

The introduction of the second 250KW transmitter, and the official opening of Radio South Africa's external broadcasts, has resulted in the reception of new frequencies in the Pacific area. The most interesting signal is on 5980KHz, in operation from 0500-0512 and 0600-0612 with programs in English for Rhodesia and Zambia and Malawi. These transmissions are heard on Monday to Saturday only; in addition, the service is on 7270KHz. Another session at 0415-0427 is on 7270 and 9525KHz. The programs in these transmissions consists of news and commentary. The address for reports is Radio South Africa, P.O. Box 8606, Johannesburg, South Africa.

The other services in operation are as follows:—

| GMT | AREA | KHz |
|---|---|---|
| 1000-1455 | Africa (General) | 7270, 92525, 11900, 15220. |
| 1600-1655 | Rhodesia, Zambia, Malawi | 5980, 7270. |
| 1700-1755 | Kenya, Uganda, Tanzania | 7270, 9525. |
| 2100-2155 | Nigeria, Ghana | 7270, 9525. |
| 2200-2255 | United Kingdom and Europe | 7270, 9525. |

This new station, Radio RSA, the Voice of South Africa, is a new voice in the short wave bands. Radio South Africa is operated by the South African Broadcasting Corporation, and is an extension of the old African service which has been on the air for some years with 20KW transmitters at Paradys. In the near future Radio South Africa is to introduce a service to the United States and Canada with four transmissions each day. Later in the year the English programs will be augmented by programs in French, Portuguese, Spanish, German and Dutch which will be in additional transmissions to Europ a later stage daily transmissions wi introduced to the Far East, Sout Asia, Australia and New Zealand, an to Latin America, thereby giving South Africa a world wide service.

### CANADIAN SIGNALS

The signals from Canada in the band have been giving very good rece and all these stations (private relays of mercial programs) have been heard b Sunday at 0800GMT onwards. The signal to be heard is generally located in Calgary, Alberta, using 603 and with the reported power of which has light music and frequent fication for CFCN, its broadcast outlet.

Another signal which is peaking time is CJCX in Sydney, Nova which is using the nearby of 6010KHz. This station relays CJC gives this call and "Radio 1270" dur announcements. The third signa 6005KHz is CFCX in Montreal, an one seems to be heard best at 093 the same type of all night program

### HAVANA CHANGES

Major changes have been made by Havana, Cuba, and these have resu signals from many of the services Havana being well received on ne quencies. The service to the Near Eas 9655 and 15155KHz both give good tion, and the program includes minute program in French at 0730-

The service to Europe from Hava 15155KHz and is on the air at 201 An additional service in English, bea South America, is on the air at 20 using 15300 and 15340KHz. The ser North America in English is n 9525KHz at 0100-0600, and from to 0600 the additional frequen 6135KHz is used.

### LATIN AMERICAN RECEPTI

The signals from South and America at about 0900 to 1200G clude some interesting signals and bo tralian and New Zealand have found that the signals from th of the world have been extremely However, the interest in these stat lessened somewhat by the low per of verifications received even when have been written in Spanish and postage sent.

Some of the recent reception items heard by members of the Au Radio DX Club. TGNA in Guatema is heard at 1115GMT on 5955KH the usual gospel broadcasts, and in to 1200GMT when the station com a Spanish transmission.

HRLC in Honduras is on 4770K is reported to be on the air at 120 when it opens its transmission. T Colombian is Radio Visian, at M on 6105KHz, which uses the call and is heard at 1000GMT.

## ARTHUR CUSHEN TO VISIT AUSTRAL

The author of these "Listening Around the World" columns, Arthur Cush will visit Australia in September and arrangements are being made for h to meet readers of "ELECTRONICS Australia" in Adelaide, Melbourne a Sydney, in that order. Interested readers should contact the following, who making the necessary arrangements in the three cities mentioned.

ADELAIDE: Jim Paris, 72 Johns Road, Prospect, Adelaide.
MELBOURNE: Bob Padula, 404 Mont Albert Road, Surrey Hills, Melbour
SYDNEY: Steve Thurlow, 40 Kauri Street, Cabramatta, N.S.W.

The dates for meetings are: Adelaide, September 1-12; Melbourne, Septem 12-16; Sydney, September 18.

mbian heard on 5970 is Radio Hori-
e in Bogota, which is best after 0930
Radio Canada leaves the frequency.
P using 6095KHz suffers sideband
ference from VL16 in Sydney, but can
eard at 1100GMT at fair level. Radio
onal at Caracas, Venezuela, on
KHz, is heard with the callsign YVMG
opens at 1055GMT, while in New
and it is also heard at 0400 during
afternoon reception period.

adio Altiplan in La Paz, Bolivia, is
d in many parts of the world at 0600-
T, using 5045KHz, but suffers some in-
rence from Radio Raratonga, on the
channel, but the Bolivian station is
from interference on Mondays, when
Island Radio does not operate.

### SUNSPOTS RISE RAPIDLY

edictions for the smooth sunspot count
he remainder of the year, as supplied
he Zurich Observatory in Switzerland,
a rapid rise in the count, which in
means rapid increase in the use of the
frequency short-wave bands, in parti-
11 and 13 metres.

e count shows May 34, June 37, July
August 43, September 45 and October
nd it is assumed that the sunspot maxi-
will be reached in July 1968 when
ighest smooth sunspot count is expect-
o be 100. The 11-year sunspot cycle
only three to four years to climb from
mum to maximum but seven years to
ease. During this coming summer more
nd 11 metre band acteivity can be anti-
ted in Australia and New Zealand.

### ELHI EXTENDS ITS SERVICES

l India Radio in Delhi has been report-
s now operating a new General Service,
transmission at 0030-0200, 0435-0930,
-1215 and 2100-2200GMT. Our own
rvations have also resulted in addi-
l services being noted, in particular
xtension of the normal service to Eur-
which is now on the air for a much
er period, 1745 to 2230GMT.

e station uses the 41, 31 and 25M
s. Our best reception is on 11905KHz
200GMT, when news in English is
d, then commentary, music and fea-
, with close down at 2230. The station
rs interference at 2210-2225GMT when
e (also on 11905KHz) has a service
ew Zealand. Delhi, when closing, gives
program as being on the air for the
ed Kingdom, Europe, Africa, Australia
New Zealand.

### THE BANDS

me readers have asked about the
al frequencies used for broadcasting.
out below are the frequencies used for
national high frequency, medium and
-wave, also the low frequency tropical
dcasting bands. The bands used for
t-wave broadcasting are close to and,
me cases, shared with the amateur ser-

vo bands in the long and medium-
section spectrum are provided for
dcasting, between 150-285KHz long
(used mainly in Europe) and the
lard broadcast band from 525 to
KHz.

bove this, the bands are regarded as
t-wave bands.

ree tropical bands provide frequencies
ose regions where static levels are so
as to make normal BC reception
ult. These bands are known as the 120,
nd 60-metre bands and include 2300-
, 32000-3400 and 4750-5060KHz.

e 75-metre band is part of the 80-
amateur band, from 3900-4000KHz.

e 49M band includes 5950-6200KHz,
the 41M band is shared with amateur
ns and covers 7100-7300KHz.

en follows the 31M band 9500-9775
, and the 25 metre band 11700-11975

e four highest bands are the 19, 16,
nd 11-metre bands and they cover
0-15450, 17700-17900, 21450-21750, and
0-26100KHz respectively.

## FLASHES FROM EVERYWHERE

**SWEDEN** has extended its service for listeners in Europe, which is on the air 0900 to 1130, and which in some periods of the year can be received in this area. The Stockholm transmission now has Spanish 0900, French 0930, German 1000, on 6065 and 9625KHz; 1030-1100 in Swedish and 1100-1130 in English using 9625KHz. This last transmission in English is also beamed to the Far East on 15190KHz.

**NEW YORK'S** Armed Forces Radio Service is on the air 1330-2245 on 15430 and 15335, 1400-1800 on 21650, 1830-2245 on 11790KHz. In addition the frequencies of 15330 and 21600KHz are beamed to Africa. The 21600KHz transmission is heard to sign off at 2245, also carrying AFRS programs to North Africa and is providing interesting 13M band reception at 2200GMT.

**SWAN ISLAND,** understood to be the location of Radio America's "Voice of Continental Truth" is heard well at 0945GMT to its opening at 1000GMT. The station uses a series of chimes interspersed with announcements in Spanish and English in which the frequencies of 1160KHz for BC and 600KHz for short-wave are given. The station address is given as P.O. Box 352, Miami 1, Florida. U.S.A. Uncertainty has arisen among some American listeners as to the exact location of the station. some conjecture that the propagation of its signals would suggest it is not on the tiny Carribbean island of Swan, but in the southern United States. Our own listening on broadcast band shows the signals are heard at the same time as those from Central and South America and come in too early to be located in the United States. The station verifies by a card, which shows the station location as Swan Island, and we can only agree with the station that this is in fact the location of the transmitters.

**MONROVIA.** Gospel station ELWA in Monrovia, Liberia is now using three frequencies in its service when it opens its transmissions in English at 1055GMT, reports World Publications Bulletin. The third frequency is 17735KHz. and the station states that 15155 and 21535KHz are also in operation. The signals on 15155KHz are the most reliable and in New Zealand have been heard at 2000 when a broadcast is being presented in French.

**MOROCCO** from Rabat use two frequencies for its services to Latin America which open at 2230GMT. The program in Spanish is on 11735KHz with the power is 100KW. The full schedule of the service is 2230-2330GMT.

**PERUVIAN** station "Radio la Hora" at Cuezco, high in the Andes, is reported to be again in operation and heard at 0510GMT using 9730KHz. The station has the callsign OAX7J assigned.

**VATICAN** Radio now has a session in English for listeners in North America, and is on the air daily 0100GMT using 5985, 7250, 9645KHz. We have also noted Vatican Radio on other new frequencies and times recently, including at 0500 on 7280KHz mixed with V.O.A., Monrovia and at 183GMT when the frequency of 5985KHz is used.

**DENMARK** over its station in Copenhagen now has a program in Spanish and Danish for reception in South America. This service is using 15165KHz and is on the air Monday, Wednesday and Friday, 2145 to 2245GMT.

**LEOPOLDVILLE** in the Congo is reported using the frequency of 7182KHz and being heard in Melbourne at 2300GMT. Bob Padula reports following the station to sign-off at 2300GMT. Another Congo station, Radio UFAC, using 5010KHz is also being heard in French to sign off at 1830GMT.

**ANGOLA** has been reported as using the frequency of 7235KHz when Radio Angola at Luanda was heard at 1725GMT with program in English, reports a listener in Zambia to Radio Australia. Angola stations are seldom beard on the 41M band due to the considerable interference in this part of the world from the many European signals being received.

**HAITI** station 4VC Radio Commercio at Port au Prince has been heard on 9480KHz when using 7500W in this service. The station is reported to be best received on this frequency from 2300 to

*The External Services News Department of the B.B.C. puts out from its headquarters at Bush House, London, 170 news programs a day, using the major international news agencies, drawing on dispatches from B.B.C. correspondents around the world and aided by reports from the B.B.C. Monitoring Service. This picture shows part of the External Services newsroom where up-to-the-minute news bulletins are compiled.*

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Name .. .. .. .. .. .. .. .. .. .. .. ..

Address .. .. .. .. .. .. .. .. .. .. ..

0300 GMT. The station now seems to be on a regular schedule after a long period of inactivity.

**BEIRUT** has made its seasonal frequency change in the English service to North America, which also provides very good reception in the South Pacific, when English is carried 0230 to 0300GMT. The station now operates on 11760KHz. The complete transmission is 0100-0400 with news bulletin at 0230. The program at 0300 is in Arabic.

**LISBON** in the service to Australasia has moved to 17889KHz for the 0730-0815 transmissions from Lisbon in English. This International Service was using the 41M band during our summer months, and the use of the 16M band has not provided such good reception as signals suffer interference.

**BANGKOK** in Thailand is frequently reported in English 1030-1125 GMT when using 11940KHz, but is seldom reported in the earlier transmission at 0415-0515 GMT. This transmission is understood to be on the air on 6160, 7185, 11910KHz. Bangkok has, for many years, verified with a folding verification card showing the map of the country and verification details. The many other Thai stations, on medium and short-wave, are operated by various Government departments, e.g. Education Department and Air Forces, and also by private companies, and are difficult to verify. Few listeners have received confirmation of the reception of the many signals from Thailand, which can be heard on both BC and SW bands.

**SWITZERLAND** has made some frequency changes in its schedule, and the service to Japan at 0700-0800 in English, has been moved from 9670 to 1632KHz. To Near and Middle East at 1515 GMT 15305KHz replaces 11865, and to Africa at 1900GMT on weekdays, 1830 on Sunday, 11810KHz replaces 959KHz.

**HAVANA,** Cuba, has a transmission to Africa and has been heard in Spanish at 1730 and in Swahili at 1800GMT using 15340KHz. At 1800 the station gives details of a further transmission at 2100 also beamed to Africa, in the normal Radio Havana - Cuba broadcasts.

**NOTES from readers should be sent to ARTHUR CUSHEN, 212 Earn Street, Invercargill, N.Z. All times are Greenwich Mean Time, add 8 hours for Perth, 10 hours for Sydney and 12 hours for Wellington time. Frequencies are now listed in kilohertz (equivalent to kilocycles) in these pages.**

**BULGARIA** is reported to be using new frequencies for another English transmission. They are now on the air 2105 to 2130 on 7765, 9700 and 11715KHz. The station's German transmission is also now heard 2000-2100 on 6070KHz.

**NORWAY,** with broadcasts from Oslo, is using the new frequency on 9550KHz for the period 0300-0430 with 1850, 9610 KHz, and power on these three frequencies is 100KW. The 11m transmitter used in the summer on a test basis has now been withdrawn.

**ANKARA** in Turkey has English transmissions 1415 to 1445 on 17850KHz and 2200-2230 on 15160KHz. The German transmission 1830-1900 and French 1900-1930 is also on 15160KHz.

**CAIRO** has added a new transmission to North America. This is in English and operates on 9595KHz, 0145-0300GMT. The 16M band stations of Radio Cairo are still giving good reception from 1500 to 1800GMT, using two frequencies, 17695 and 17785KHz.

**BELIZE** in British Honduras is reported to have increased in power, and is on 3300KHz. The station which is well received in North America has BBC news at 0300 and a gospel program at 0330. The station sign off is 0400 or at times as late as 0410.

**AFRICAN** signals reported by Bob Padula, of Melbourne, include Radio Mauritius using 4850KHz which is
heard with BBC news at 1800 and
off at 1830GMT. The station is hea
well on the BC frequency of 682
operating from Forrest Side. Reuni
also reported from St. Denis on 244
closing at 1830GMT. Programs a
French the station closing at 1830
At times its BC outlet on 602KH
also been heard. Kenya is also rep
as being heard with its English Se
on 4885KHz, and vernacular prograr
4934KHz are noted at 1900 GMT
morse interference is often seve
these frequencies, as is now comm
most 60M band transmissions at this

## BROADCAST BAND NEWS

FIJI—The Fiji Broadcasting Comm
in Suva has made a frequency chan
its key station VRH which has be
930KHz for some years. The VRH
now uses 560KHz, and the stati
heard well opening in E
at 1800GMT, when they also give the
Lutoka station on 890KHz and some
wave channels as carrying the Englis
gram. The Fijian service is heard on
in Suva using 710KHz. No mention is
of the experimental station VRH11
KHz, which has also been heard open
1800GMT on occasions. The new frec
of 560KHz should give better recept
the Fiji area as interference on this fr
cy will be less than that experienced o
KHz. Moreover the lower frequency
give better reception in the primary
area.

NEW ZEALAND—Information fro
New Zealand Broadcasting Corp
gives news on new stations to com
operation. The first of these new s
took the air on July 9. This is 1
Tokoroa on 1480KHz, which has a
transmitter at Wiltsdown, and stud
Bridge Street. The station operates M
to Saturday 6 a.m. to 11.20 p.m. and S
9 a.m. to 11.20 p.m. New Zealand
which is Sunday to Friday 1800 to
Monday to Saturday, and Saturday 2
sign off 1120 GMT on Sunday.

The second new station, 1ZU at T
runui, will have its studio and tran
at Huia Street in Taumarunui. It w
1KW on 1520KHz, and be on the
the same schedule as 1ZO. The oper
1ZU is not scheduled but is expected
in August or September. There are pl
new stations for Whakatane or Ke
but no action is being taken on thes
jects at present. A new relay sta
proposed for the National program t
Whangarei, and Northland. The r
station for Whangarei, will have the
of 2KW but no information is availa
the call sign of the station, or the fre
to be allocated as this proposed sta
still in the planning stages.

RADIO HAURAKI—Latest news
off-shore radio station to broadc
Auckland, New Zealand is that the
will use the power of 2000W and
on 1450KHz. The station will be loc
a 93-foot vessel anchored outside the
mile limit, at a point near Cape C
between Great Barrier and Little
Islands. The operators plan to ha
station in operation by October, and
the air on the projected schedule of
to 10 p.m. Monday to Friday, 5 a.m.
day to 2 a.m. Sunday, and 9 a.m.
p.m. on Sunday, New Zealand time.

The station coverage area is from
garei in the north to Hamilton in the
and includes the Bay of Plenty, b
expected that it will give a service t
out New Zealand of fair signal lev
frequency chosen, 1450KHz, is not
the best available, and the present t
the use of lower frequencies by the
stations off the British Coast, to
stronger signal in the primary c
area, could well be followed by
Hauraki.

# TECHNICAL BOOKS AND PUBLICATIONS

## ITCHING WAVEFORMS—"most comprehensive work"

**SE, DIGITAL AND SWITCHING AVEFORMS: Devices and circuits for ir generation and processing. By Jacob llman, Ph.D., and Herbert Taub, D. Published by McGraw-Hill Book , New York, 1965. Hard covers, n x 9½in, 958pp., many circuits and grams. Price in Australia $15.75.**

s impressive volume was originally ed by the authors as the second edi- of their now-established and highly re- ed **Pulse and Digital Circuits** (Mc- -Hill, 1956). However, it was found so much new material had been , and so extensive and thorough had the revisions that a new title seemed rather more appropriate.

the authors mention in their preface, half the topics in the new book did appear in the earlier work; and of aterial that was presented in the latter, t every section has been completely ten. This very major overhaul has made necessary by the rapid develop- which have taken place recently in ield and, particularly, by the shift in asis from thermionic valves to tran- s and other semi-conductor devices.

authors were well fitted for the task oducing a modern textbook on pulse igital techniques. Dr Millman is Pro- of Electrical Engineering at Columbia ersity; Dr Taub is his counterpart City College of the City University w York. As academics, both have a us technical background as well as ng in methods of teaching and ex- on.

the present volume they have, indeed, ded the engineering student and prac- engineer with a most comprehensive nce work. And not only is it com- nsive, but thorough as well.

ile the reader is generally assumed ave sufficient background in mathe- s to be familiar with linear differential ions with constant coefficients, alge- and other mathematical manipulation een kept to a minimum. The basic od of exposition adopted is to first se circuits on a physical basis in order ovide a clear understanding of their behaviour, following with a mathematical expression of quantitative relationships only after the physical analysis is properly established. Every effort has thus been made to combine rigour with lucidity.

Semi-conductor and valve circuits are generally presented on a side-by-side basis, but with the principal emphasis on semiconductors in view of their widespread use. Practical devices and parameter figures are used in discussion to assist the reader in dealing with practical design problems.

The 20 chapters are headed: 1—Review of Selected Topics in Electronic Circuit Theory. 2—Linear Wave Shaping. 3—Pulse Transformers and Delay Lines. 4—Wideband Amplifiers (uncompensated). 5—Wideband Amplifiers (Compensated). 6—Steady-state Switching Characteristics of Devices. 7—Clipping and Comparator Circuits. 8—Clamping and Switching Circuits. 9—Logic Circuits. 10—Bistable Multivibrators. 11—Monostable and Astable Multivibrators. 12 — Negative-resistance Devices. 13—Negative-resistance Switching Circuits. 14—Voltage Time-base Generators. 15—Current Time-base Generators. 16—Blocking-oscillator Circuits. 17—Sampling Gates. 18—Counting and Timing. 19—Synchronisation and Frequency Division. 20—Transient Switching Characteristics of Diodes and Transistors.

Each chapter ends with selected references covering the topics treated, and there are a large number of worked examples given throughout the text. The book ends with a number of mathematical appendices and some 135 pages of self-tuition problems covering the material of all 20 chapters. These features together with the excellent presentation of up-to-date material make the book eminently suitable for use as a text in colleges and universities.

And, of course, it should be invaluable to the practising engineer and senior technician as a reference. I know of no other modern text of greater or even equivalent scope.

Our copy came direct from the publisher, but copies are available at large bookstores. (J.R.)

## A TRANSMISSION—"valuable reference"

**A TRANSMISSION, by William R. Bennett and James R. Davey. Pub- ished by McGraw-Hill Book Company, New York, 1965. Hard covers, 6in x 9¼in, 356pp., many diagrams. Price n Australia $15.25.**

aim of this book is to present a rehensive treatment of the modern iques and equipment used for accurate rapid transmission of data from one to another. It is intended mainly for engineers concerned with the develop- of digital data communication equip- and for those who specify and operate equipment. However, the treatment is iently general and qualitative to make uite informative for the general eering-level and senior student reader.

authors are well qualified in the data mission field: W. R. Bennett is Head e Data Theory department at Bell hone Labs., and J. R. Davey is Head e Data Terminals and Transmission department of the same organisation. The commendable readability of their work is possibly a function of their considerable experience in both theory and practice of data transmission.

The book begins with a short but most interesting historical review of data transmission systems. Then follows sections dealing with digital information, its electrical representation and frequency analysis.

The effects of restricted bandwidth and transmission impairments are then discussed. This is followed by chapters dealing with baseband systems, AM, FM and PM systems and a comparison of modulation systems.

The remaining sections of the book deal mainly with practical communication systems of past and (primarily) present. After a review there follow chapters on establishing a reference carrier for synchronous detection, methods of synchronisation, equalisation of data channels, performance measurement, error control, idealised optimalisation theory and statistics of digital signals.

Each chapter concludes with a list of selected references, and both name and subject indices are given at the rear of the book. Throughout the text concepts are quite clearly presented and amply illustrated with diagrams and graphs, with adequate mathematical analysis where required.

In short, then, a valuable reference in this modern and important field.

Our copy came direct from the publisher, but we understand that copies are already available from the larger bookstores. (J.R.)

## UHF PROPAGATION

**ULTRA HIGH FREQUENCY PROPAGATION Second Edition, by Henry R. Reed, Ph.D., and Carl M. Russell, M.S., "Science Paperback" SP-17, published by Chapman and Hall Ltd., London, 1966. Large Crown 8vo (8in x 5¼in), 562pp. Many charts and diagrams. Price in U.K. 30s net.**

Fairly definitely a book for engineers, this one, and then of principal interest to those in the UHF propagation field. The mathematical and physical level assumed in the reader is that of the recent graduate, and while the presentation is of a high standard the specialised subject matter and predominantly mathematical exposition will make it of little interest to those seeking a general understanding.

Within the specialised context, however, the book would seem to be very comprehensive and thorough in its treatment. The chapter headings are as follows:

1. An Introduction to UHF Communications and the System Concept.
2. General Aspects of Propagation.
3. Meteorological Theory.
4. Antennas and Radiation Phenomena.
5. Multipath Propagation.
6. Comparison of VHF and UHF Propagation, Dipole-to-Dipole.
7. Complex Antennas (Linear Arrays).
8. Complex Antennas (Circularly Polarised Antennas).
9. System Comparison, Operation and Design of UHF Complex Antennas.

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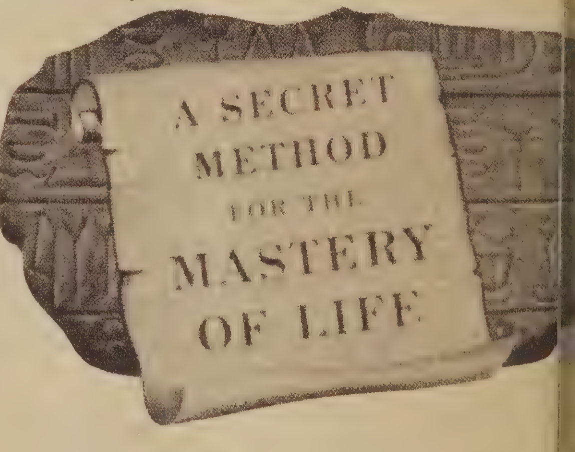

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eneral Operational Considerations.
lustrative Systems Design Problems.

copy came direct from the publisher
o information regarding local price or
bility was supplied. However, copies
no doubt, be available from the larger
ellers in the near future. (J.R.)

★ ★ ★

**LARD VOLTAGE REGULATOR
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y Mullard Limited, London, and avail-
ble in Australia from Mullard-Austra-
a Pty. Ltd., 35-43 Clarence Street,
ydney. Paper cover, size 8¼ x 5¼in,
0 pp., plus fold-out range chart. Price
5c plus postage 7c.**

book begins with a short account of
erating principles of voltage regulator
(taking time to put the Mullard view-
in the controversy about the accuracy
term "Zener" when applied to volt-
egulator diodes) but the main portion
text deals with design problems and
ations.

treatment is largely mathematical,
he book may therefore be considered
inly for engineers, especially those en-
on development work. A particularly
section for those in this category
with an approach to the design of a
sing circuit. This takes the reader a
t a time through the mathematics re-
to determine stabilisation factor,
nal change of co-efficient and output
nce. This is followed by a discussion
design procedure for a stabilising cir-
ith series transistor. The remainder of
ook deals with applications in more
l terms.
six chapters are entitled: Character-
Mullard Voltage Regulator Diodes;
e Reference Circuits; Voltage Shift-
Circuits; Voltage Clipping Circuits;
laneous Applications.
book conforms to the high standard
evious Mullard publications and is
letterpress on good quality art paper.
rous illustrations are included through-
e book, and a fold-out multi-coloured
chart is included. At the low price
this book represents very good value.
T.)

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## RATURE—in brief

**WLETT-PACKARD JOURNAL,** Vol.
o. 9 (May, 1966) has a lengthy article
new Hewlett-Packard Model 8405, a
Voltmeter, described as an important
nstrument for amplitude and phase
rements from 1MHz to 1,000MHz.
s a combined broadband two-channel
ltmeter and phasemeter which simpli-
ch measurements as device gain and
mpedance and admittance, length in-
ies in transmission paths, and pre-
frequency comparisons.
econd article deals with a portable
-powered multi-function meter for
tory use, with useful range from
to 4MHz at levels below one milli-
H.P. Model 427A). The instrument
a sensitive DC voltmeter and ohm-

iries should be sent to Hewlett-
rd's Australian agents, Sample Elec-
(Vic.) Pty. Ltd., 9-11 Cremorne
Richmond, Vic.

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nsive pulser with rise times less than
(frequences 40 to 300Hz) to a very
elaborate unit with repetition rates up to 200MHz and rise times less than 1nS. Inquiries, on company letterhead, should be sent to Amalgamated Wireless (Australasia) Ltd., Engineering Products Division, 47 York Street, Sydney.

**EMERSON AND CUMING, INC.,** of Canton, Massachusetts, U.S.A., have published a new, up-to-date version of their pamphlet explaining how to build a high performance RF shielded room using the Eccoshield CP system of metal-clad panels and joint sealing components. The pamphlet discusses the important considerations to be taken into account in the design of the enclosure, how to build a new back-up structure, or how to convert an existing room into a shielded room. A quick method for calculating materials is also given. Detailed drawings show how to put together the different types of joints and corners encountered in assembling the enclosure.

Inquiries should be sent in the first instance to Emerson and Cuming agents, Wm. J. McLellan and Co. Pty. Ltd., The Crescent, Kingsgrove, N.S.W.

**STANDARDS ASSOCIATION OF AUSTRALIA** is seeking comment on a series of draft Australian standard dimensions for semiconductor devices, issued as Doc. 1054. This document comprises the complete text, without amendment, of the International Electrotechnical Commission's Publication 191-2; Mechanical Standardisation of Semiconductor Devices. It includes device outline, base, case outline, and gauge drawings, as well as tables showing relationship between case outlines and bases.

Comment on the proposal that this IEC document be adopted as an Australian standard is invited from persons or organisations experienced in the manufacture or use of the above-mentioned equipment, and should reach the association not later than 30/9/66. Copies of Doc. 1054 may be obtained for $1 a copy from the headquarters of the association, 157 Gloucester Street, Sydney, or from branch offices in capital cities and Newcastle.

**STC COMPONENTS AND EQUIPMENT REVIEW,** Vol. 3, No. 5 (May, 1966) has an interesting article on Zener diodes (reprinted in the July issue of this magazine); also information about a number of ITT components. These are the TAG range of solid electrolyte tantalum capacitors, available in the range 0.1 to 50uF, with working voltages from 3V to 35V DC; silicon rectifiers, type IS1333; transverse flow blowers; Intermetall Zener diodes; silicon planar photo transistor PD31. Also described are Metalohm close tolerance metal film resistors, miniature relays Type 24 and 25 and high performance power tetrode, Type 4ZC/300J. (Standard Telephones and Cables Pty. Ltd., Moorebank Avenue, Liverpool, N.S.W.).

**SPRAGUE ENGINEERING BULLETIN,** No. 2875 deals exclusively with paper and paper/film commutating capacitors for silicon-controlled rectifiers and other square-wave voltage applications. Detailed information about the various ranges of capacitors in this category are given in this eight-page bulletin, including an application guide, case dimensions, ratings and performance data. Agents for Sprague products in Australia are Cannon Electric Pty. Ltd., 58 Cluden Street, East Brighton, Victoria.

**TECHNICAL NEWS BULLETIN** Vol. 50, No. 4 (April, 1966) published in U.S.A. by the National Bureau of Standards, contains the following articles: Direct Communication between man and computer; Standards and Calibration: changes in N.B.S. broadcasts; Rapid separation of macromolecules and virus particles; Heat of formation of aluminium fluoride; New mass spectrometric data centre; Bonding of tile and paint to treated concrete; Modular technique gives accurate HF instruments; Wavelength dependance in thermopiles observed; Pressure transducer's response

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affected by thermal gradients;
factors for fires in test models; First
symposium on materials research. (In
to Superintendent of Documents,
Government Printing Office, Wash
D.C., 20402.

**MARCONI INSTRUMENTA**
Vol. 10, No. 4 (May, 1966) has
entitled: Return to Step Atten
Oscilloscope Type TF2201; Signal
tors — Source Impedance or
Impedance?; A General Purpose
scope Type TF 2203; VHF C
Techniques with Range Unit
TM8267; UHF Attenuator Type T
(Inquiries to Amalgamated
(Australasia) Ltd., Engineering P
Division, 47 York Street, Sydney.)

## PROJECT APOLL

(Continued from page 11)

From the demodulators, infor
is fed through the various data
sors. The PCM processor decomm
the telemetry bit stream. The
is then fed into the 642B co
where it is stored, processed an
tinent information is transmitted
Mission Control Centre. A second
computer stores digital comman
transmission to the spacecraft
designated time.

Perhaps the most interestin
original development within the
system is its binary ranging cod
lowing its excellent performance
Jet Propulsion Laboratory syst
seemed an obvious choice for the
mission, where an accurate,
method of range finding was esse

Basically four digital code gen
are driven at a 1MHz rate w
twice the receiver clock freque
500KHz This code then cont
total number of bits before re
equal to the multiple of the len
the individual code generators an
component. The clock com
lengths is two bits, X code com
length is 11 bits, A code com
length is 31 bits, B code com
length is 63 bits, C code com
length is 127 bits. Within eac
component length, the bits are
random — thus giving a random
repeated successively in predete
order; hence the title "pseudo-
range system."

The length in bits of the tota
is the product of the length in
the individual components, or 5,
bits.

To determine range, the
ranging code is compared with th
mitted ranging code. To find a
correlation, a total of 232 co
readings may be made. The
component is first removed a
readings correlated, then each
other elements are removed in tu
Doppler tally, plus the number
required to be made, together
a measure of range. As sign
ratio deteriorates with distance, th
ing process can be set to integ
results of several correlations.

This then is an outline of the
Unified S-Band System at Ca
Tracking Station. To man and
this equipment Amalgamated
(Australasia) Ltd., employs 21 e
and technicians who have
NASA training courses in the
As the program develops, more s
be required until the Carnarvon
ing Station is fully performing
role — man's conquest of th
through the Apollo program.

# ANSWERS TO CORRESPONDENTS

**hen writing to us:—**

**Please give your name and full postal address, including the State . . . N.S.W. &c.**

**Write the above information clearly or, for preference, print it in block letters. Your co-operation will facilitate delivery of replies by mail, where such are called for.**

---

### GET WELL GADGETS

**(Aylington, Vic.)** thinks that we were skating on thin ice in our recent discussion of "get well" circuits and gadgets.

e realm of the subjective, "thin ice" is rly common pheomenon and some of things said about "get well" gadgets certainly find a parallel in other fields ought. But we are happy to stand by we said and to limit the discussion e original topic; electronic get well es!

### TRANSISTOR AMPLIFIER

**. (Hunters Hill, N.S.W.)** writes to say how pleased he is with the performance of a Playmaster 112 silicon transistor control unit he built recently, and expresses his interest in a "no holds barred" design for a matching transistor power amplifier along the general lines of the 17W Playmaster valve amplifier.

are pleased to know that you are ied with the performance of the Play-er control unit, but we cannot say at stage when we shall be able to proceed the design of a super-quality matching r amplifier. As Jamieson Rowe pointed n his reference to such a project in the h issue (page 39) it would depend on availability of time and of there being ient interest in such a design — at price it may turn out to be. At this it is still too early to say just what nterest is.

### TWIN PENTODES

**(Auckland, N.Z.)** draws our attention o the ELL80 twin pentode and wonders whether we have in mind to describe an amplifier using it.

have not seriously considered the , mainly because the number of enve- are the same using a twin-triode wed by a twin-pentode, as when using more conventional triode-pentodes. We t that any difference in heater current d influence the choice or cost of power former in a typical kit design, which ally provides a margin for supplemen- preamplifier stages and radio tuner. shall keep the suggestion in mind, ver, if another amplifier along these comes up for consideration.

### PLAYMASTER 110

**(Royston Park, S.A.)** says he was disappointed that our Playmaster 110 tape system used valves instead of solid state and that it had too many facilities, likely to appeal to only a limited number of readers.

choice of valves or transistors for pe system, or techniques for that r, is not entirely an arbitrary one, influenced by the impedance of the s offered on available decks and the iques envisaged in the deck design. situation is therefore somewhat different from that of a complete commercial unit, which is designed from the first with particular end in view. We agree, however, that the case for valves in tape recorders is weakening. As for the facilities, some want them, some don't. What is certain is that there is a place in the scheme of things for both concepts and there were plenty of readers who saw in the 110 unit the very thing they had been looking for.

### READER BUILT IT

**R.P. (Mt. Hawthorn, W.A.)** wants to submit an article for the "Reader Built It" page and asks how to go about this.

We are not sure that we exactly understand your problem, R.P., but the following may help. There are no formalities to be observed; if you have an article which you feel would interest other readers, simply post it to us, together with such circuit diagrams, drawings, or photographs you feel are necessary to illustrate it. Drawings need only be in rough form, since our own draughtsman normally re-draws these for publication. However, they must be clearly set out so that we can copy them accurately. Photographs need not be large, but must be sharply focused and of good contrast. "Box camera" efforts are unlikely to be successful. Articles accepted for publication are paid for at ruling rates.

### VIDEO TAPE RECORDER

**C.F.K. (South Perth W.A.)** wants to know if we intend to publish a project on building a complete domestic closed circuit TV system, including camera, monitor, and economical video tape recorder. He also wants to know if we have plans for a transistor tuner and transistor tape unit to suit the control unit and amplifier of December 1965 and March 1966.

That's quite a tall order, C.F.K. So tall, that we wonder if you realise just what is involved in developing a project of this kind. Some of the best equipped laboratories in the world have been working on the design of a practical, economical home video tape recorder for several years and must have spent, literally, millions of dollars on the idea. And, although significant improvements in tape recorder design have resulted, the video equivalent of the audio tape recorder is still "just around the corner" — and likely to remain there for a while yet. In these circumstances, it is rather less than realistic to suggest that such a project should be undertaken by an organisation like ourselves with —relatively — modest equipment and financial resources. The other items are more in keeping with our facilities, and we will keep the suggestions in mind. We have no immediate plans along these lines, however.

### ANONYMOUS COMPLAINT

**A letter, carrying neither signature nor address asks:**

"What kind of people do you permit to advertise in your magazine?" The letter goes on to complain that a certain firm (named) took three months to forward goods ordered, and have still not completed the transaction satisfactorily, after repeated requests.

We might well retort by asking: What kind of reader makes accusations of this kind behind the cloak of anonymity? We have no direct control over our advertisers, who simply buy space and use it as they see fit. However, where there appears to be a genuine misunderstanding between reader and advertiser, we will do what we can to clarify the situation. This applies to the above reader, if he cares to re-submit his problem in a signed letter, so that we can take up his particular complaint.

### SW CONVERTER

**A.D.P. (Woomera, S.A.)** writes telling of his success with our short-wave converter of April 1965. He asks whether we may plan to produce a transistorised equivalent of this converter.

The possibility of such a converter has been discussed from time to time but nothing concrete has been decided. There are some problems with such a unit, not the smallest being that an additional stage would be required to give the same performance that can be achieved by the use of only one valve. We will, however, keep this suggestion on our list of possible projects for future reference.

## "ELECTRONICS Australia" INFORMATION SERVICE

TO assist readers, "ELECTRONICS Australia" conducts a technical information service. Conditions governing this service are set out below:—

(1) Address letters to: Assistant Editor, "ELECTRONICS Australia," Box 2728, G.P.O., Sydney.

(2) Requests for copies of circuits or technical information requiring a postal reply must be accompanied by postal note or stamps to the value of $0-20 (2/-). Queries not accompanied by a fee will be answered in rotation on these pages.

(3) For the $0-20 fee, we will supply circuit data, as available, from our files. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for circuits will be answered more speedily if they are not complicated by questions requiring the attention of technical personnel. Where articles are not on file we can usually provide a photostat copy at $0-20 PER PAGE.

(4) The information service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits. Please note that the inclusion of an extra fee does NOT entitle correspondents to special considerations.

(5) The editor reserves the right to return fees or to limit the scope of an individual reply when it is felt that a partial answer will be better than none at all.

(6) In addition to the above service, chassis blueprints are available for most of our projects showing the position of holes and cutouts for metal-working, but containing no details of wiring. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost $0-50 (5/-) each. Original photographs of most projects are also available, from $0-50 for a 6in x 8in glossy print, postage $0-08 (9d).

(7) "ELECTRONICS Australia" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications should be obtained from advertisers.

(8) Technical queries are not answered by telephone.

(9) We have no file of circuits for commercial radio or TV sets, etc.

(10) A fairly good range of back numbers is available. On issues up to 6 months old there is a surcharge of 5c (6d). On issues from 7 to 12 months old the surcharge is 10c (1/-). Over 12 months, it is 20c (2/-).

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## SAPPHIRES — Continued from page

ruby, which is simply sapphire to which a small percentage of chromium oxide has been added.

Sapphire plays an important role in laser systems beyond its relationship with ruby.

One of the requirements in a laser system is for high quality mirrors which will withstand the high energy laser pulses. Here sapphire assumes a very important role.

Without going into detail, a precisely fabricated sapphire flat window can provide 26 per cent reflection by virtue of the air-dielectric interface; higher reflectivities are obtained by stacking together in a very particular way additional sapphire flats.

Only sapphire is able to withstand the intense energy of the laser beam. Also, sapphire holders for the laser rods are of increasing interest.

Some of the reasons for using sapphire in this application are that its thermal expansion and that of ruby can be considered as identical, thus eliminati problems when the laser system is ated at cryogenic temperatures.

The high thermal conductivity c phire compared to metals is a ageous.

There are many other important cations, but the above examples c broad spectrum and illustrate how of the superior qualities of sapph advantageously employed.

It is hoped that the backgrou formation coupled with examples plications will provide sufficient i for more consideration to the use phire in engineering applications previously it had been immediate missed because of the false notio sapphire falls into the category of and costly gem.

Sapphire really is not so expens only sounds so, but performs as it were.

("Electronics Weekly," 27/4/66.)

## VOICE OPERATED SWITCH—Continued from page

tape recorder. As there could be so many versions and combinations of this approach, we must leave this aspect of the project to the ingenuity of the constructor.

Earlier, we mentioned the 39K resistor in the base circuit of the second transistor. When the job of wiring has been completed and the unit is switched on, without being connected up with the recorder, the relay should remain in the unoperated condition. Actually, when first switching on, the relay will possibly operate momentarily and then release. If the relay operates and does not release, without any signal, the trouble should be cleared by reducing the value of the 39K resistor.

As a 33K resistor will more than likely be too small, the best way is to shunt the existing 39K with a high starting with, say, 220K. A valu be chosen so that the relay wi out as soon as the 39K is shunte it. Do not use too low a value, will slow down the attack time. original development circuit, 39 correct. Subsequently. in the mod presented, we found it necess shunt this value with 100K.

As there are so many tape re available in this country, we regr we cannot undertake the task of ing queries as to how each in recorder should be dealt with. would take up more time than w available for answering such However, with the information there should be little if any diffi putting it to practical use.

## ERRATA

**SIMPLE IMPEDANCE METER, March, 1965.** Error in circuit diagram on page 41. The positions of S1 shown beneath the diagram have been reversed and should read position 1, 10pF-100pF and 1mH-10mH, Position 2, 100pF-.002uF and 27uH-1mH.

**LOGIC AND COUNTING CIRCUITS. July, 1966.** The diagram marked as Figure 7 on Page 45 was in error. It should be replaced by the diagram at right, which has been reproduced to the same size to allow it to be pasted over the original.

**1966 3-INCH OSCILLOSCOPE 1966.** A single-pole 3-position switch was omitted from th list given on page 43 of th 1966 issue.

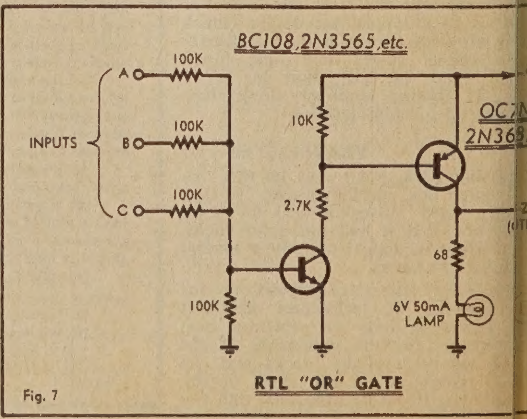

Fig. 7

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s, 38 Carbine St, Kerang, Vic.

. 960 Transistor Radio Analyst as new
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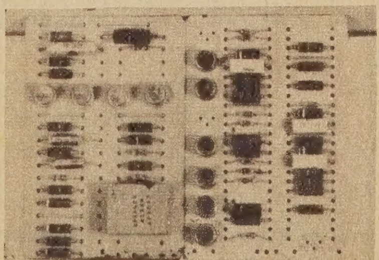

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